MAP SUPPLEMENT: NORTHWESTERN UNITED STATES

VOL. 117, NO. 4 APRIL, 1960

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THE JOURNAL OF THE NATIONAL GEOGRAPHIC SOCIETY WASHINGTON, D. C.

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16th & M Streets N.W. *Washington 6, D. C.*

National Geographic Magazine

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COVER: *Jet-propelled diving saucer glides through the Caribbean's blue depths* (page 571).

VOL. 117, No. 4 WASHINGTON APRIL, 1960

THE NATIONAL GEOGRAPHIC MAGAZINE

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Frontiers of the wild meet those of science and industry in a land where fish hold college reunions and automobiles fly

Northwest Wonderland: Washington State

By MERLE SEVERY
National Geographic Staff

Illustrations by National Geographic Chief Photographer B. ANTHONY STEWART

THE SILVER JETLINER streaked down Seattle's Boeing Field and lifted gracefully into the air. Sitting beside me, Boeing Airplane President William M. Allen checked his wrist watch. "Off the ground in exactly 25 seconds. Not bad for 120 tons of plane."

Lake Washington and the floating bridge dropped behind; we climbed sharply—half a mile a minute—over the dairylands of King County and up through swirling mists.

Leveling off, our Boeing 707 floated almost soundlessly at nearly 600 miles an hour. Ahead a line of Cascade peaks rose like islands in a sea of clouds: Baker, Rainier, Adams, St. Helens, and beyond, in Oregon, Mount Hood.

"Spectacular," Allen said. "But more than that, they form one of the world's most striking climatic boundaries."

Parts of western Washington, I had heard, get the heaviest rainfall in the continental United States. Across the Cascade Range, parts of eastern Washington are so dry they say the jack rabbits have to pack canteens.

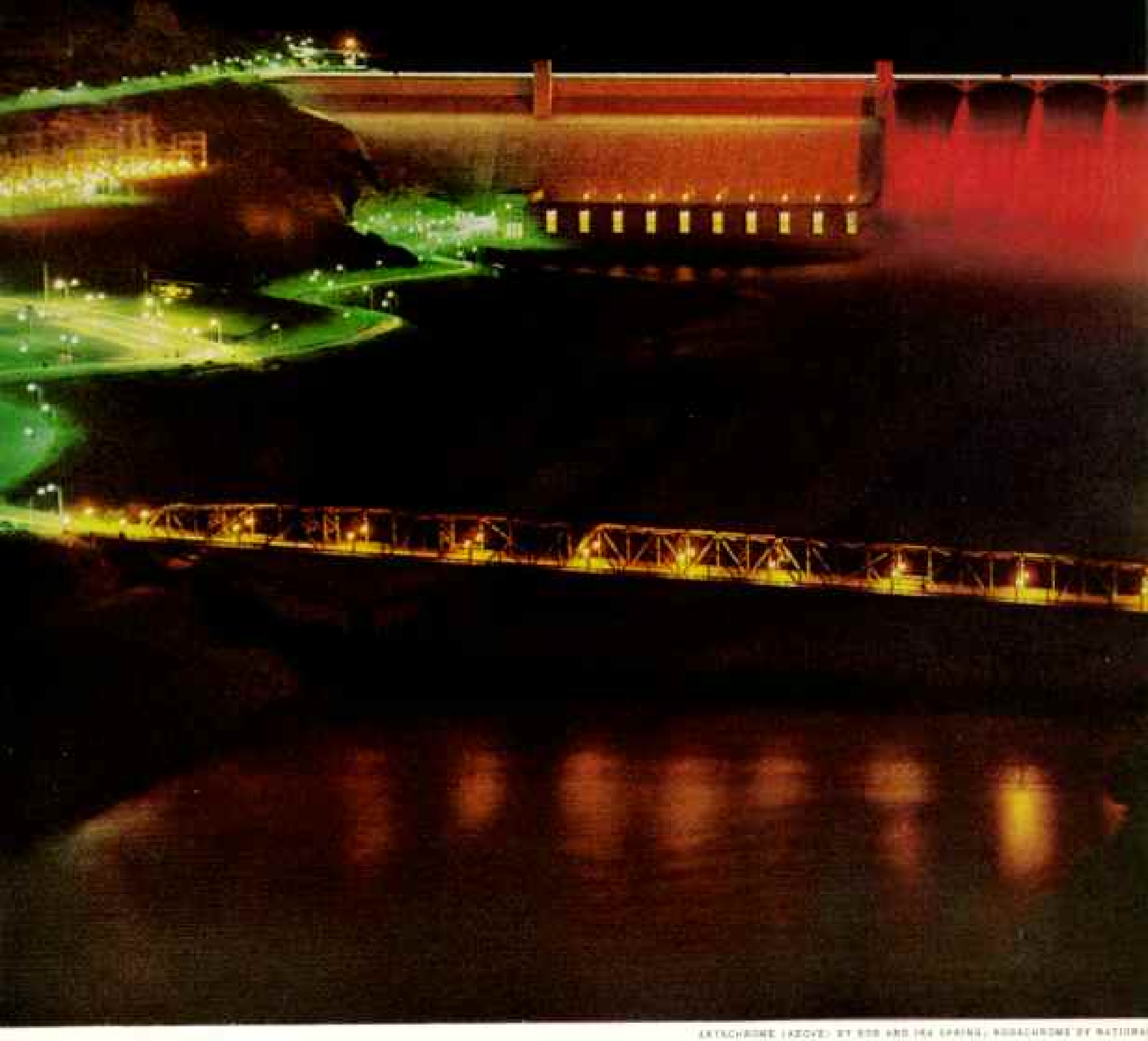
Minutes later I saw dramatic proof. Clouds abruptly ended as we soared high above the white-flecked crests. Gone was the moist green quilt of forest and grass. Instead, a stark and barren land baked in the sun.

But I was growing accustomed to surprises in the Pacific Northwest, where nature's last frontiers stand alongside those of science and industry; where salmon climb ladders and hold reunions on a university campus, where apples are colored to order, automobiles fly, and skiers schuss down snowy slopes on the Fourth of July.

Trees Grow "Two Looks" Tall

Smallest of Western States, Washington looks big to Eastern eyes. It is larger than all the New England States put together—six times as large as my home State of Maryland. Its mountains and rivers are big, its trees so tall "you have to look twice to see their tops," its spirit as big as all outdoors.

Its rousing story begins with man's quest for the Northwest Passage, surges on with the clash of fur empires on the Columbia, plays the bold theme of Manifest Destiny, sounds the cry "Fifty-four forty or fight." Here is an outsized saga of wagons rolling west over the Oregon Trail, of the boisterous era of logging camp and skid road, of the days when



EKTACHROME (ABOVE) BY ROB AND NANCY SPRING; KODACHROME BY NATIONAL

track-laying crews tackled the Cascades to the boast, "With enough Swedes and whiskey, we'll build you a railroad to hell!"

Mostly it's a story of men and women who carved homes from the wilderness—and, finding the land good, worked to make it better.

Six miles above the Columbia Basin, I looked down on a huge bowl where 20th-century pioneers make the desert pulse with life.

To the east rose Spokane and golden wheat fields of the Palouse Hills. South lay Walla Walla and the Blue Mountains; the Tri-Cities of Richland, Pasco, and Kennewick; and amid scab rock and sagebrush, the atomic energy works at Hanford. To the west spread orchard valleys of Yakima and Wenatchee in the shadow of the Cascades. North, beyond a bend in the Columbia, rolled timber and cattle reserves of the Okanogan Highlands.

We circled over one of man's most massive structures, Grand Coulee Dam—a white toy threaded on a silver ribbon.

Pivoting on Mount Baker, our giant airliner swung west along the 49th parallel—the Canadian border—and reached the sea at Blaine, where a peace arch symbolizes the friendship between neighboring countries.

"There's Point Roberts," Allen said, "a chunk of Washington isolated from the rest of the State across Boundary Bay. Point Roberts children who go by bus to school in Blaine cross the border four times a day."

We banked over the San Juan islands and headed south to Washington's greatest gift from the Ice Age: Puget Sound. In 1792 English navigator George Vancouver explored this inland sea cradled between the Olympic Mountains and the Cascades. Vancouver named it for his lieutenant, Peter Puget. And while his botanist, Archibald Menzies, was "regaled with a salubrious & vivifying air impregnated with the balsamic fragrance of the surrounding Pinery," Vancouver wrote:

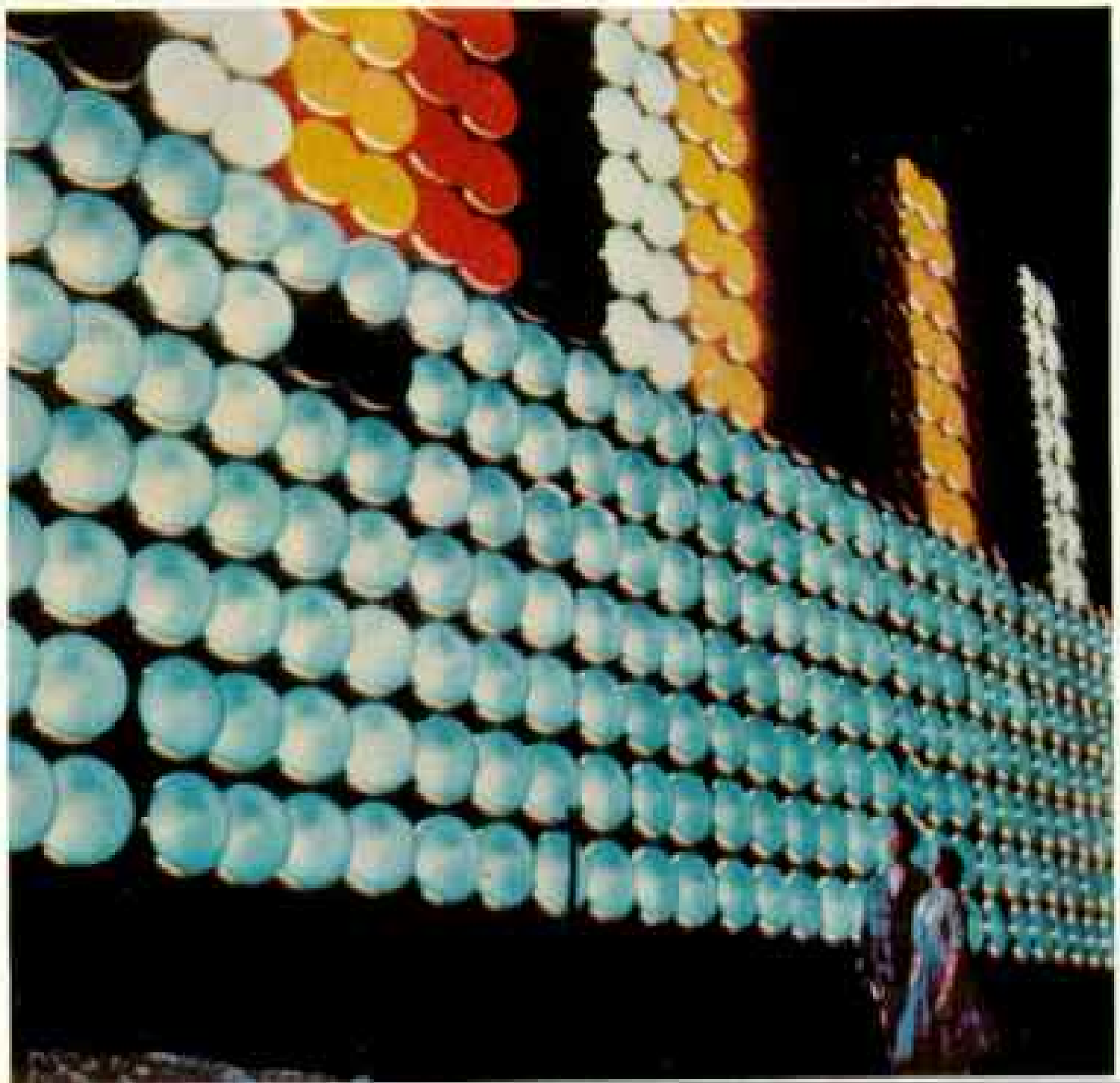
"The serenity of the climate, the innumer-

GEOGRAPHIC PHOTOGRAPHER B. ANTHONY STEWART © N.G.S.

Grand Coulee Turns On a Flaming Waterfall

Largest concrete structure in the Nation, the dam stretches 4,173 feet across the Columbia. Roosevelt Lake, Grand Coulee's reservoir, backs up 151 miles to the Canadian border; its waters will irrigate a million acres in central Washington. Eleven gates above the spillway unleash a cascade twice as high as Niagara's.

Lights of the town of Coulee Dam, Washington, glitter at right.



Giant floodlights throw rainbow colors against the spillway. Each globe casts a 1,500-watt glow.

Boeing's 600-mile-an-hour Birds Line Up to Get Their Final Ground Checks

Jetliners await their purchasers at the company's plant at Renton, near Seattle. A lone Boeing 720, designed for shorter-range domestic service, stands among larger ocean-spanning 707's. The jets represent the latest chapter in the 44-year story of a firm that built its first airplanes of spruce spars and piano wire. Today's work force of 60,000 makes the company the largest employer in Washington.

Faced with a post-World War II slump in orders, the firm staked its future on the success of projected multijet giants. From this gamble came the Strategic Air Command's B-47 and B-52 bombers, KC-135 tankers and the sleek 707 airliner.

To assure safety in the 707 jet transport, engineers tortured a test plane literally to destruction. Suspending the craft on steel scaffolding, they applied enormous pressures with hydraulic jacks. After enduring incredible stresses—far beyond any expected flight loads—the plane's wings crumpled like a fallen bird's.

Bullet-nosed Bomarc missiles, which will pack nuclear warheads against enemy aircraft 400 miles away, roll along assembly lines in Seattle. Boeing's other Space Age projects include Dyna-Soar, a manned vehicle that will operate in and out of earth's atmosphere and return to a normal landing, and the Minuteman, a solid-fuel ICBM that will span 6,300 miles in less than half an hour.

able pleasing landscapes, and the abundant fertility that unassisted nature puts forth, require only to be enriched by the industry of man with villages, mansions, cottages, and other buildings, to render it the most lovely country that can be imagined."

Vancouver was right. Had he flown with us, he would have gazed down at Bellingham, Anacortes, Everett, with their great fish packing plants, oil refineries, and lumber mills; Lynden's dairies, and the poultry farms at Mount Vernon. He would see ships from all over the world steam into magnificent harbors at Seattle and Tacoma; fishing fleets, pleasure boats, ferries busily threading the islands. He

KODACHROME (ABOVE) AND HIGH SPEED EKTACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER B. ANTHONY STEWART © N.G.S.

would mark the capitol buildings of Olympia (page 460), and everywhere the homes of a thriving and happy people (see the accompanying Atlas Map, and article on page 515).

And yet in a way Puget Sound is still a frontier. Air Force, Navy, and Army installations here guard not only the northwest approaches to the United States but prime Washington State targets—Hanford, Grand Coulee, aircraft plants, and other factories.

Now we were over Bremerton with its Puget Sound Naval Shipyard, largest on the Pacific coast. Here aircraft carriers are modernized, cruisers are converted into missile ships, and old warships are moth-balled.

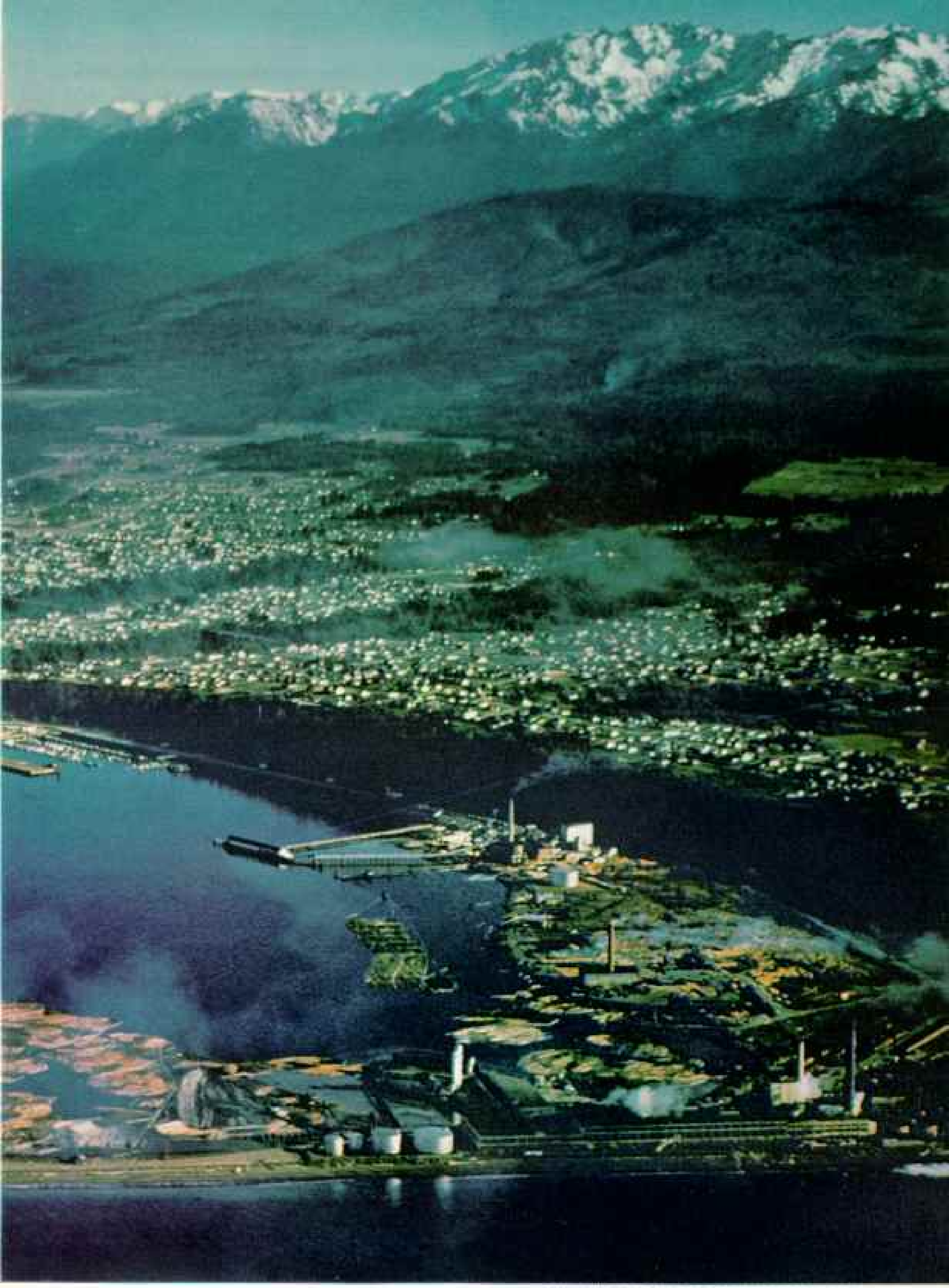
The Tacoma Narrows Bridge came into sight, and Allen told the story of "Galloping Gertie," its ill-fated predecessor that had collapsed into the sound during a gale in 1940. "The center span still lies on the bottom," he said, "so boats in the narrows go under one bridge and over the other."

Tacoma's 47 square miles of homes, smelters, mills, grain elevators, and parklands rolled by on the shores of Commencement Bay. Floating log booms told of lumber's part in the city's success.

Then the plane headed inland over the daffodil fields of Puyallup Valley and dropped down to give us a thrilling look into Rainier's

Port Angeles, Gate to Olympic National Park, Expands Mountainward From the Sea

Early boosters envisioned the area as a second District of Columbia. President Lincoln set aside 3,520 acres for Federal use, but the order was



KODACHROME BY RAY ATKESON © NATIONAL GEOGRAPHIC SOCIETY

revoked. Port Angeles grew on the site. In this view, log booms cluster beside Ediz Hook, a sandbar sea wall jutting into the Strait of Juan de Fuca. Crown Zellerbach's mill at lower right produces 500 tons of newsprint a day. Klahane Ridge towers above the city.

crater. Climbers near the summit must have stared goggle-eyed as the big jet all but scraped the glaciers at 600 miles an hour. In the plane we held our breath as ice, snow, and rock whizzed by.

"That's the way I like to climb Rainier," Allen smiled.

Next day I went through Boeing's Renton plant, which produces the plane that still surprises Bill Allen himself.

Wings, fuselage, engines, and other parts met on two giant assembly lines: 707's on one side, KC-135's on the other. I noted that the KC-135, the Air Force jet tanker-transport version of the 707, was shorter and slimmer, carried a fuel boom under its tail, and had no sound suppressors on its engines.

"They cut engine efficiency about four percent," Gordon Williams of Boeing's transport division told me. "The Air Force wants full power, and never mind the noise."

Every three working days a KC-135 rolls out the door, every 2½ days a 707. The plane then goes to the paint shop, is fitted out with seats, and undergoes final checking at the delivery center (page 449).

Space Food and Extraterrestrial Gas

At Boeing's new Missile Center in Seattle I watched the supersonic Bomarc being built (page 448). And in the new 30-million-dollar Developmental Center I saw tomorrow taking shape. Scientists here develop special alloys, study extraterrestrial gases, seek ways to grow food on interplanetary voyages, experiment with devices that not long ago were but a gleam in a science-fiction writer's eye.

In the office of Dr. Walter F. Hiltner I saw models and blueprints of space vehicles, and blackboards covered with complex formulas and diagrams.

I was puzzled by rock samples on the desk.

Dr. Hiltner chuckled. "My secretary asked whether they came from the moon!" he said. "Wish they had—we'd like to know what we'll be landing on."

Though these scientists and engineers solve problems of space flight for a living, weekends find many of them in boats.

The boat could well be a symbol of Wash-

Tacoma Children Trade Stares With the Nation's Tallest Totem Pole

Northwest coast Indians gained prestige by depicting myths, ancestry, and feats of bravery on family poles. Tacoma businessmen in 1903 imported Indian carvers from Alaska to shape this 83-foot mast.

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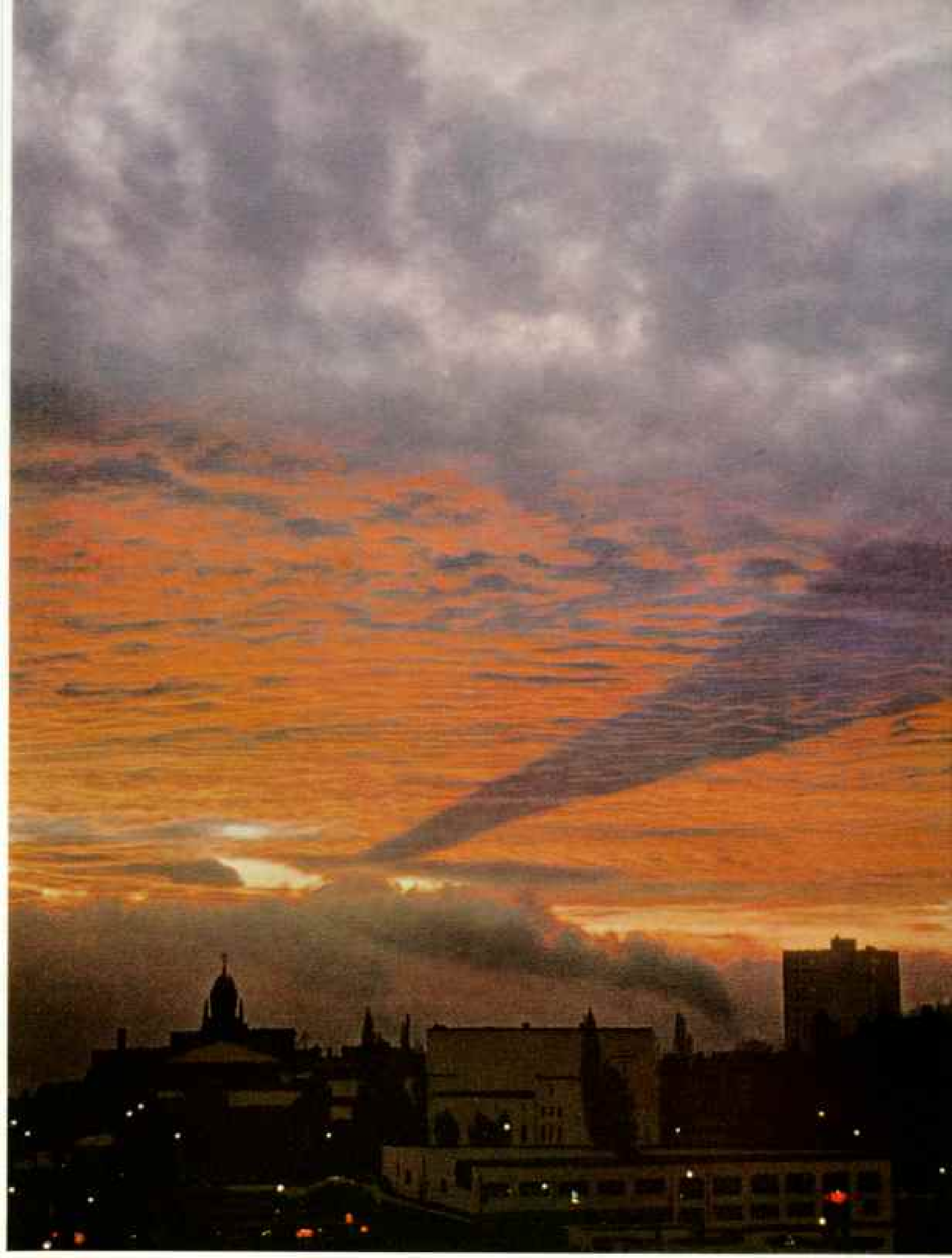


KODACHROME BY PAUL S. THOMAS © NATIONAL GEOGRAPHIC SOCIETY

Mount Rainier's Long Shadow Streaks Dawn's Fiery Clouds Above Tacoma

Dwelling beside Puget Sound in sight of majestic peaks, Tacoma's 157,000 people thrive on shipping and a diversified industry that ranges from candy to plywood. In this rare photograph Mount Rainier, 45 miles away, casts an upside-down shadow that reaches over the awakening city itself. Fog hides the bulk of the mountain.

ington. Many an owner coddles his boat in the garage while a station wagon stands forlornly outside; many a $300 car pulls a $3,000 boat. That boat spells freedom. With it, every man has an unfenced domain of his own.

"No better way to escape from problems and telephones," young insurance executive Phil Simon told me as we bowled up Puget Sound aboard his outboard cruiser, *Nomis*. Phil's wife, Dolores, and their two sons, Daryl and Richmond, sprawled on deck in the sun.

Baker and other Cascade peaks hung a curtain of snow beyond the smokestacks of Everett to our right; Whidbey Island's green shores rolled by on our left. At Langley we headed inshore to picnic on a driftwood table while Phil told me the stages of Washington's boat fever (page 458).

Seems you start off with an outboard motor to go fishing; you can always rent the boat. Then you buy or build an open 12- to 14-footer and putt along happily, until you see people going out farther into the sound. So you trade her in on a 16-foot outboard cruiser, pile children and sleeping bags aboard, and set out for weekend cruises. You put in to sleep under the stars, ashore or aboard—until the kids' legs get too long.

Friends invite you on their inboard cruiser. You think about the convenience of a galley

KODACHROME BY B. ANTHONY STEWART © N.G.S.

KODACHROME BY ROS ANGLISS SPRING © N.G.S.

Japanese fish-net float, beached near Tokeland after bobbing five thousand miles across the Pacific, fascinates youngsters at play among driftwood.

Weekend Visitors and Hoh Indians Fish Side by Side on Ruby Beach

Early explorers avoided this section of the Pacific coast after Indians slew two landing parties. Near-by Destruction Island derives its name from the seamen's deaths. Today city folk and reservation tribesmen net surf smelt, which ride in on the tides to lay eggs in the sand. Hooks will not do; the fish spurn bait in any form.

and a head, the fun of having guests aboard. Before you know it, you're eyeing a 21-footer. "Turn your car in on a boat," dealers urge.

Recently the Simons graduated to an even larger boat, in a three-way partnership with Bellevue neighbors. Soon they would be off for a ten-day cruise of Canadian coastal waters. "But we're having trouble with one partner, an electronics technician," Phil said. "He wants to install a radiotelephone!"

Late that afternoon I watched the Simon boys help load *Vomis* onto the trailer and hose her down without anyone saying a word.

"Boats are good for discipline," Dolores said. "Things have to be done fast and right; no time for quibbling. Besides, being part of the crew makes children feel important."

In this family State of nearly three million people, children and adults do things together. Visitors sometimes ask why Spokane and Seattle, cosmopolitan cities, don't have more night life and amusements. The answer is simple. People don't need them. Entertainment focuses on the home, the patio, and the great out of doors.

Young as States go (it turned 70 last November), Washington attracts the young—and the young at heart. Servicemen and tourists have come back to settle and raise a booming baby crop. "Our community has

Sharp-shelled razor clams, which can cut knuckles and fingers, lure eager diggers at Copalis Beach. The expert searches sands still wet with the retreating tide until he sees telltale bubbles emitted by the clam's siphons. Then he digs swiftly lest his prey burrow deeper.

Clam digging ranks as a major weekend sport. Cars by thousands line accessible beaches, spilling out hunters armed with narrow shovels called clam guns. A favorite Washington joke: "I've eaten so many clams that my stomach rises and falls with the tide."

Dungeness Bay Digger's Reward: Two Gweduc, Giant Clams

Seafood lovers esteem the "gooey duck," largest clam on the continent. The species is found from northern California to British Columbia. Large shells attain seven inches in length; siphons may stretch 35 inches.

This man has dug two five-pounders, about average weight, from the tidal flats near Port Angeles on the Strait of Juan de Fuca. Before long their fat, outstretched siphons will retract by as much as two-thirds.

KODACHROMES BY B. ANTHONY STEWART (TOP) AND RAY SPRUNG © N.G.S.

more children under school age than in all the 12 grades put together," one farm wife told me.

Growing cities and new industries lure young professional people. Median age in Richland, the "Atomic City," is 26.6. Seattle's energetic Mayor Gordon S. Clinton was elected at 35. U. S. Senator Henry M. Jackson was first elected to Congress in 1940 at the age of 28.

On the other hand, the average citizen of Ryderwood must be nearly 70. Ryderwood, a logging town that ran out of logs, seemed destined for ghost-township—until an enterprising realtor made it a haven for retired folk. They have come from all over the country, to hunt, fish in their own lake, work on houses and gardens, and kick up their heels at Saturday night dances.

I watched Ryderwood's gray-headed youngsters at work and play, then moved on to Vancouver to learn more about that youthful gray metal, aluminum, basic raw material for Washington State's aircraft industry.

Dies Treat Aluminum Like Toothpaste

World War II brought the aluminum industry to Washington, where new generators at Bonneville and Grand Coulee could furnish the enormous power that smelters and rolling mills demand. Plants at Vancouver, Longview, Tacoma, Spokane, and Troutdale in Oregon, produced aluminum for U. S. planes in World War II. The Korean War brought further expansion and a new smelter at Wenatchee. Today Washington still leads the Nation in aluminum production capacity.

At the Alcoa plant along the Columbia River at Vancouver, I peered into huge electrolytic cells that convert powdery alumina into glowing metal. I saw the metal cast into pigs and ingots.

In the extrusion mill ingots of aluminum were squeezed through dies like toothpaste from a tube, emerging as stock for door and window frames, molding—an infinite variety of useful shapes.

In an adjoining mill six-foot, 245-pound ingots were rolled and drawn into 18,000 feet of wire ⅛ of an inch thick. Other machines strand the wire over a steel core to make high-tension transmission lines (page 463).

Here was a complete circle! Columbia River power runs the aluminum plants that produce the cable that transmits the river's power. It sounded almost like perpetual motion. Then I heard the portentous words "interruptible power" and "brownouts."

Power shortages in the Columbia Basin, possessor of two-fifths of the Nation's entire hydroelectric potential, where Grand Coulee is power personified?

I had stood on the shores of Columbia Lake—where the Columbia River begins amid the Rocky Mountains in British Columbia. By light plane and car I had traced its deep-walled loops through the lavas of eastern Washington and followed it west along the boundary with Oregon. In the Columbia Gorge I saw where the majestic river, having marshaled the strength of many tributaries, at last burst the Cascades barrier to the sea.

No longer is the Columbia a wilderness highway for trappers. Gone are the falls where Indians scooped salmon. Gone the solitudes "Where rolls the Oregon, and hears no sound, save his own dashings," imagined by William Cullen Bryant in his poem *Thanatopsis*.

Instead I saw a harnessed giant, blocked by dams, pouring its energy into turbines, its water into irrigation canals, piling up into lakes to carry tugs and barges. High-tension towers carried the Columbia's electrical energy to industry's machines.

Today the river is a powerhouse. It drops 2,650 feet from source to sea—the height of 16 Niagaras. Draining more than a quarter of a million square miles, the Columbia system each year builds up potential energy equal to two million tank cars of fuel oil.

Surely North America's most powerful river must have power to spare.

But in Olympia Earl Coe, Director of Washington's Department of Conservation and Development, brought me up to date.

"When Bonneville and Grand Coulee were built back in depression days, people asked who'd use all that hydro power," Coe said. "Now we can't build dams fast enough."

Power Lies Locked in Glaciers

When the aluminum industry came to Washington, it drew others, attracted by the Nation's lowest power rates. Biggest consumer of all is the atomic plant at Hanford, where plutonium is made from uranium. Hanford's eight production reactors use as much electricity as Washington, D. C.

Coe picked up a pencil and shaded between two parallel lines. "This is firm power, the kind that lets you turn on your lights any time." He drew a curved line above. "This is the Columbia system's great summer flow from snow and glacier melt in the mountains.

"We vitally need storage dams to harvest this water, not only for power, but for such other purposes as flood control. But high,

multipurpose storage dams are controversial. And there's the problem of backing storage water up into Canada.

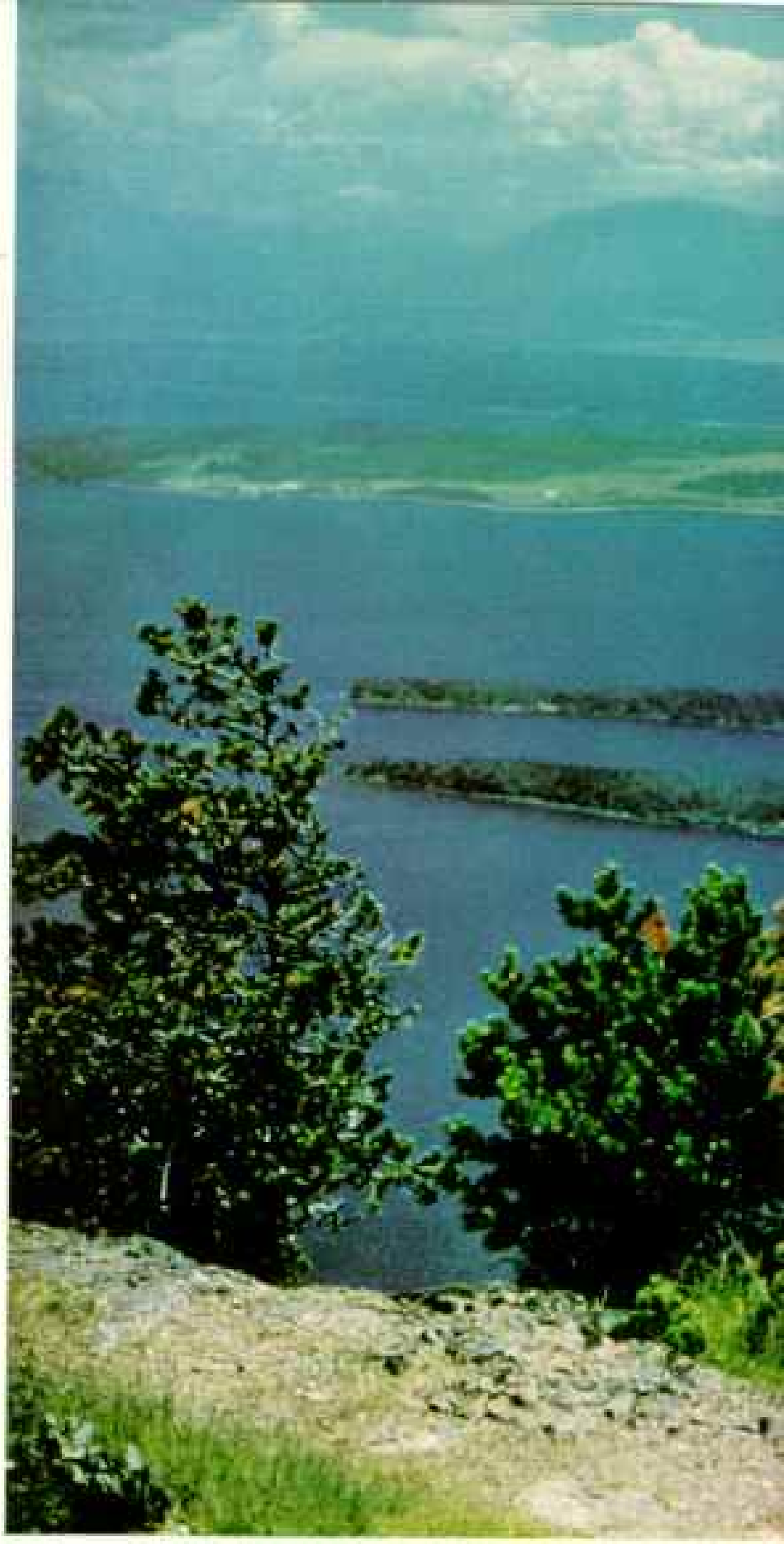
"That's why we've gone into thermal research. Washington has 63 billion tons of coal reserves. Our first coal-fired steam plant will go in at Cle Elum on the eastern slopes of the Cascades."

In the Tacoma office of the U. S. Geological Survey, a young glaciologist threw unexpected light on the subject of water resources. Mark Meier's crew cut head is often literally above the clouds, but he had a lot of practical things to say about power locked in ice.

A glacier is a big frozen reservoir, self-regulating at that. In a cool, wet year it stores water as ice. In a warm, dry year heavy runoff restores the flow of dried-up streams.

"Can glacial melting be artificially regulated?" I asked.

"The Russians and Chinese have tried it," Meier said. "They spread soot on the ice in



Standing on Mount Constitution, visitors to Moran State Park, Orcas Island, look across evergreen-studded islets to the mainland. Orcas is in the San Juans, 172 specks of land at the mouth of Puget Sound.

Sizzling hotdogs reward the Phil Simon family after a cruise to Whidbey Island in Puget Sound, whose 2,000 square miles of water delight weekend sailors. The sound offers shoreside parks, concrete landing ramps, sunny beaches, and 95 kinds of food fish. Thousands of small craft cleave placid bays and inlets in good weather.

KODACHROMES BY B. ANTHONY STEWART (ABOVE) AND BERNIE TERRY, NATIONAL GEOGRAPHIC STAFF © N.G.S.

an attempt to increase runoff during droughts."

This could be important for Washington. It contains at least 80 percent of all glacial ice in the United States, outside Alaska. Washington boasts America's most-studied glacier—Nisqually on Rainier, probed and examined since 1905 (page 481). The State also has glaciers in the northern Cascades that engineers haven't begun to scrutinize.

"Here are enormous stores of water to turn the turbines, water the fields, and serve the cities," Meier said. "Since 1946 these glaciers have been growing bigger year by year."

I was intrigued by what I had heard of the Northwest Power Pool, a system tying Federal, public, and private generating facilities into a unified grid. Clif Erdahl in Tacoma told me that the pool included British Columbia, Washington, Oregon, Idaho, and western Montana.

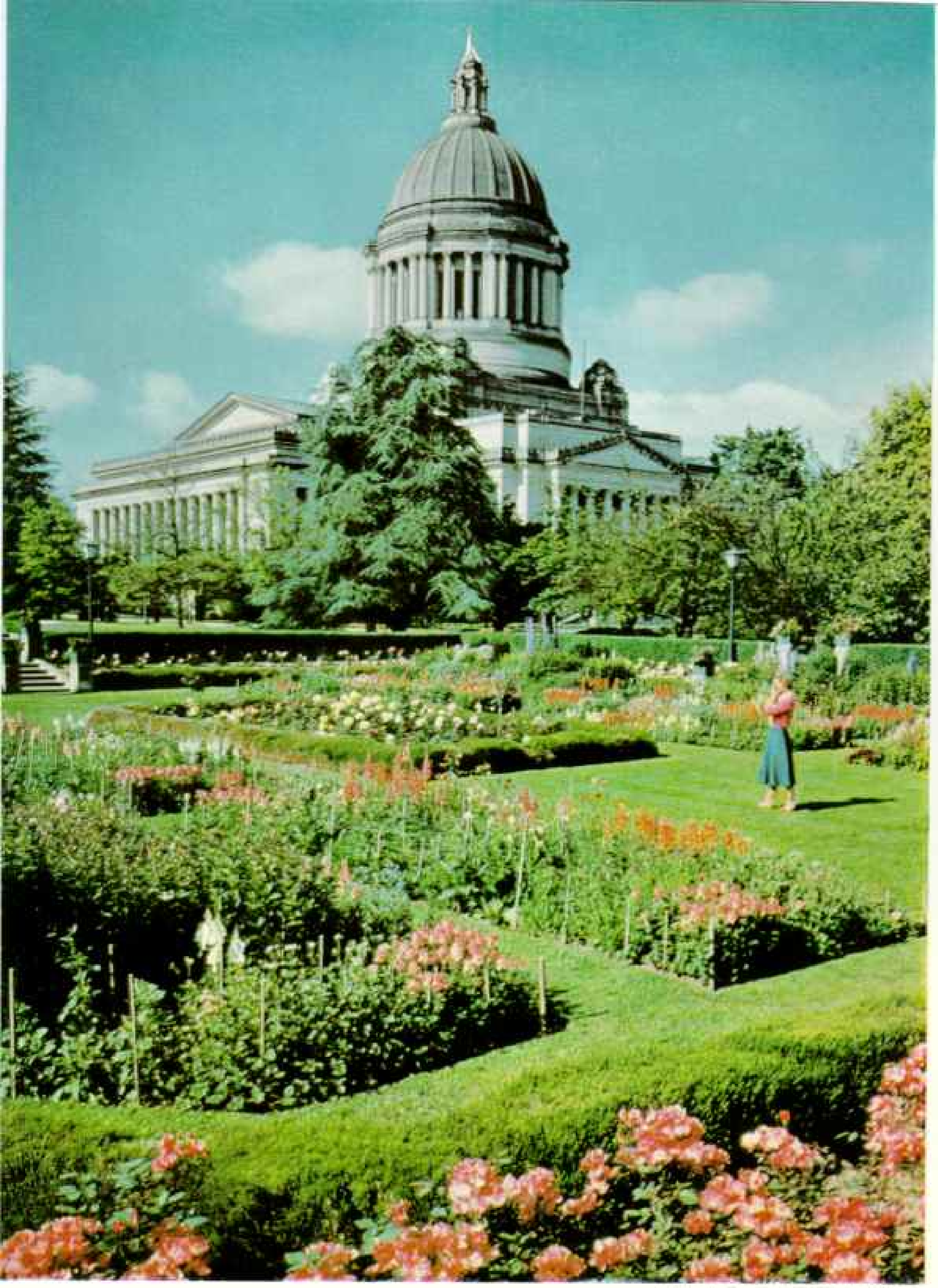
"We've gained at least 600,000 kilowatts of firm power by integrating," brisk, gray-haired Erdahl said. "Here's how it works.

"When there's high water on the Columbia, we have low water west of the Cascades. Tacoma shuts down to fill its reservoirs, Bonneville and other generators pick up the load; nobody loses service. When Grand Coulee's powerhouse flooded out in '53, who pumped power into the system? Seattle and Tacoma and other plants. If there's trouble in British Columbia, we can help our Canadian friends with power from as far away as Utah."

"What about future load growth?" I asked.

"If we built all hydro projects that are feasible, they would take care of our needs for 15 years at the outside," Erdahl told me. "Fossil fuels will have to bridge the power gap between hydro and atomic energy."

Washington's ultimate answer to the power problem lies in the 620-square-mile Hanford Atomic Products Operation. To see it, I rode



KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

State Capitol's Lawns Blaze With Roses, Verbenas, and Snapdragons

The Legislative Building towers 287 feet above Olympia, capital city since Washington became a territory 107 years ago. Completed in 1928, the domed landmark crowns a knoll called the Campus, whose 55 acres include nine other State buildings. Here Gov. Albert Rosellini greets citizens each weekday noon. Summer finds some 75 kinds of shrubs and flowers abloom in the Sunken Garden, which draws thousands of visitors.

with Jim Grafton of the General Electric Company through a sea of sagebrush, the bluffs of the Columbia River on one side, eroded Rattlesnake Hills on the other. Every few miles clustered buildings rose: a reactor's gray concrete mass, flanked by silvery water towers and the twin smokestacks of a stand-by power station.

Hanford plutonium went into the atomic bombs of World War II. Hanford makes plutonium for the Nation's defense today, and develops peaceful atomic uses that hold exciting promise for the world of tomorrow.* A tremendous story—and appropriately it started with a bang.

In 1943 all was jack rabbits, sage, and solitude. Suddenly there were 45,000 men crawling all over the place. A roaring tar-paper metropolis grew. Workers began to build something: just what, they hadn't the vaguest idea. Some thought submarines; "light bulbs," others jested. Not until Hiroshima was Hanford's awesome secret revealed.

A Nation on the threshold of the Atomic Age had need of an even larger Hanford, so in 1947 expansion began that hasn't yet ended.

Just what *does* Hanford do? Basically it manufactures plutonium from uranium. Plutonium, which does not exist in nature, is fissionable; only a small fraction (one part in 140) of uranium is the kind that fissions, or splits, thereby producing energy.

The heart of the operation is a massive cube of graphite—as big as a five-story building. Into this core white-frocked workers slide hundreds of aluminum-jacketed "slugs," or cylinders, of uranium. A chain reaction begins. The neutron bombardment continues for months, gradually transmuting nonfissionable U-238 into plutonium 239.

Plutonium Turns to Peaceful Task

Hanford's great appetite for electricity stems in large part from its pumps, which must pour millions of gallons of water through the reactors' tubes to carry off tremendous heat. In later steps, chemistry sorts out the plutonium from the uranium slugs and processes it into atomic fuel.

Sound easy? To do it yourself, all you need is a billion-dollar installation, the Columbia River, Grand Coulee power, a reservation half as big as Rhode Island, some uranium, and 8,000 highly trained employees!

Hanford has a new $15,000,000 gimmick up its radioactive sleeve: a plutonium recycle test reactor that may provide a major breakthrough in harnessing the atom to produce low-cost electricity.

It will use uranium fuel enriched with plutonium. This marks the first large-scale nonweapons use of plutonium in the United States. Further, it will operate on an almost self-sustaining cycle, since only a little new fuel must be added to replace that "burned up." The hoped-for result of the 10-year test program: a reactor that will produce its own plutonium while turning out electricity.

Counter Clicks at Author's Hot Foot

I wanted to see what other wonders Hanford had in store.

In the new plutonium fabrication pilot plant, I saw a miniature rolling mill where plutonium or uranium rods are made; and a machine shop that never dirties a machinist's hands. Lathes and other equipment are inside "glove boxes"—Plexiglas cases under partial vacuum, with arm-length rubber gloves reaching in through handholes.

Modern housewives would feel eerily at home in the plant's atomic kitchen: dough mixer, blenders, ovens, even a rolling pin, if you'll accept a 200-ton press for that.

I donned lab coat and canvas shoe covers to inspect a "hot" radiometallurgy lab.

"You can't examine coal after it has burned, but you can uranium," Lou Turner, the lab manager, told me. "Our job is to find out what happened, so the engineers can develop a fuel that will last longer and cost less."

A technician picked up a sample inside a windowed steel cell with a "Hanford slave"—a manipulator that looked like a toy crane in an amusement park, but worked a lot better. Other men were removing test capsules from a lead-lined cylinder in underwater storage.

"Two of my men will be 'burned out' soon," Turner said. "When they near the permissible limit, we put them on low-level radiation work. Some jobs are so 'hot' a few minutes are enough for the day."

I checked out at a monitoring device that clicks off radiation levels. A radium-dialed watch will drive the machine mad.

"You've got a hot foot," Turner announced. I didn't feel a thing—but thought it prudent to replace the canvas cover on my left shoe. My lapel badge also would record radiation. When I turned it in, they'd develop the film inside. And if it showed too high a level?

"You might be yanked off your plane at the

* See "You and the Obedient Atom," by Allan C. Fisher, Jr., NATIONAL GEOGRAPHIC, September, 1958.

next stop for treatment," Turner said cheerfully. Actually, Hanford is one of the safest plants in the world. To date, no employee has been injured by radioactivity.

Constant check is made to see that no dangerous contamination spreads through the countryside. Technicians fish the Columbia to assess radiation levels there, and at the meteorological tower scientists showed me how fog and smoke tests determine the dispersion of mildly radioactive gases.

In the "100F Area" I heard unexpected sounds—from baaing sheep, grunting miniature pigs, barking dogs, the pampered subjects of lifetime radiation studies on Hanford's experimental animal farm.

Outside the radiobiology laboratory I met a college student in a blue smock beating the bushes with an insect net. "I'm getting food for a lizard," he grinned sheepishly. Inside the lab I saw it: a desert whiptail which is fed irradiated insects.

These are only a hint of Hanford's wide-ranging experiments. The purchasing officer doesn't bat an eyelash when labs requisition odd items like essence of canary feathers; two dozen duck eggs not over 24 hours old (for allergy testing); a calfskin less than eight hours off the animal (for a filter).

"Windjammers" Fight Apple Frostbite

I looked next around Hanford's headquarters city of Richland. Lt. Thomas W. Symons of the U. S. Army would scratch his head in disbelief were he to come by today. Symons led a survey party through this area in 1881 and reported: "It is a desolation where even the most hopeful can find nothing in its future prospects to cheer."

Richland, a village of 250 before the atom splitters took over, has grown to a proud city of 28,000.

Neighboring Kennewick, grape juice capital of the Northwest, and Pasco, a transportation hub with an electronic freight classification yard 47 tracks wide, have shared in the region's explosive growth. Prospects are bright for industrial and port development along McNary Reservoir, present head of navigation on the Columbia, and the Tri-Cities have already become the fifth largest metropolitan district in the Northwest.

With McNary Reservoir at their doorsteps, citizens 292 miles from the sea are just as boat-happy as residents along Puget Sound. Their vessels crowd the new marina; their water skis carve the Columbia on weekends.

If atoms, rails, and barges are building the Tri-Cities apace, fruit has spelled the steady —if less spectacular—growth of Yakima and Wenatchee.

These are beautiful valleys along the Yakima, Wenatchee, Columbia, and Okanogan Rivers—beautiful in winter when the gnarled limbs stand stark against a light blanket of snow; beautiful in spring when blossoms envelop them in clouds of pink; beautiful in summer when the patterned green of the orchards contrasts with tawny hills and gleaming white Cascade peaks.

Canals bring water from icy mountain streams and distribute it among trees in rills and sprinkler systems. For apples need 36 to 40 inches of water each year, and nature hereabouts provides only eight—less than parts of the Sahara receive. "Windjammers" —airplane propellers on towers—and smudge pots keep chill night air from settling on blossoming trees. Helicopters, biplanes, and speed sprayers war on insects and diseases.

Munching my way through the orchards, I learned to distinguish Jonathan from Winesap, Yellow Newtown from Golden Delicious. My favorite: the Red Delicious, so snappy and succulent that when you crunch into it the juice rolls down your cheeks (page 466).

I watched skilled crews hand-pick the crop and followed the bins to packing plants where apples are washed, sorted, graded, and packed for market, or held in cold storage for later shipment or canning. Culls go

Coiled Rods of Aluminum Feed a Wire Mill at Vancouver

More than three million miles of aluminum power lines span the Nation. Once as costly as gold, the light metal sells for 26 cents a pound and finds hundreds of uses, from watch hands to bridge girders. To make wire, Alcoa draws these rods through successively smaller dies.

into cider and chips. In one Yakima plant I saw an honest-to-goodness apple polisher!

By then I thought I knew a thing or two about apples—until I dropped in at Washington State University's Tree Fruit Experiment Station at Wenatchee. Here apple wizards told me of chemical thinners that knock off weaker blossoms so a tree won't overproduce one year and exhaust itself for the next. They've got insecticides that cut spraying time in half; nitrogen treatments that produce bigger fruit; hormone sprays that hold fruit on trees until it attains its richest color.

Apple Sports Make Better Eating

"Washington must produce big quantities of better fruit," Dr. L. P. (Jack) Batjer of the U. S. Department of Agriculture told me. "We can't move an equal apple into Eastern markets when we have $1.25 a box freight charge. It has to be a better apple."

An apple tree begins to produce a fair crop in seven or eight years, sometimes still bears when a century old. But Washington's orchard industry is constantly turning over its trees as new varieties catch the public fancy.

Two sports (mutant varieties), the Starking and the Richared, stole the limelight from their parent, the Standard Delicious. Growers replaced these in turn with "supersports" (sports of sports) after a freeze in 1955 killed almost every tree under eight years old. When these varieties come into heavy production in the next few years, many older trees will ruthlessly be replaced. The latest trend? Dwarf trees, that produce years earlier, are easier to pick and thin.

Central Washington doesn't put all its fruit in one basket. Yakima County also leads the Nation in cherries, pears, and hops; ships huge quantities of peaches, plums, and apricots. Its rangelands and feed pens—like those of neighboring Ellensburg—are full of Hereford and black Angus steers. Ponderosa pine forests keep its lumber mills buzzing.

But the apple is king. In a good year 50 million dollars' worth of these red and golden ambassadors make friends for Washington State all over the Nation and abroad.

The historian Bancroft tells a charming story of how the apple came to Washington. "The first fruit-tree grown on the Columbia sprang from the seed of an apple eaten at a dinner-party in London," he wrote. A lady

placed the seeds in the waistcoat pocket of a sea captain, who did not remember them until he again wore the garment while dining at Fort Vancouver in 1827. He gave the seeds to the gardener, who planted them, "and thence within the territory . . . began the growth of apple-trees."

Today Fort Vancouver National Monument serves to remind us that for a quarter of a century here stood the center of commerce and civilization on the Columbia, the most populous settlement in half a continent.

As Superintendent Frank Hjört described life within the Hudson's Bay Company palisade, I could envision blacksmiths forging beaver traps, and clamorous arrivals and departures of fur brigades. Towering above all was the black-clad figure of the "White-headed Eagle," as the Indians called Dr. John McLoughlin in mingled awe and respect. Between 1824 and 1846 he ruled west of the Rockies, from Spanish California to Russian Alaska, with a fist of iron. This enigmatic man carved an empire out of raw wilderness —and dined in elegance on Spode china. His sternness was tempered by mercy.

Company policy discouraged American settlement in the Oregon country, which included present-day Washington. But McLoughlin could not withhold food, seeds, and tools from weary, starving settlers. When his London directors ordered him to desist, he gave help from his own pocket. Finally forced out for aiding Americans, McLoughlin settled at Oregon City and became a U. S. citizen.

He was deprived of holdings, bilked of money owed him, and died a lonely man. All too late did the American settlers realize that McLoughlin was a man to build statues to.

"Stinking Fogges" Greet Explorer

How can this ungrateful conduct be explained? The settlers still regarded him as a pro-British Hudson's Bay man, and in 1846 Northwest tempers ran high in a momentous dispute. The roots of this clash lay deep.

A powerful magnet drew Francis Drake in 1578-9 through Cape Horn's "hell-darke nightes and the mercyless fury of tempestuous storms" and up the Pacific coast into a region of "most vile, thicke, and stinking fogges." It was the quest for the fabled Northwest Passage. His search fruitless, he sailed the *Golden Hind* on around the world.

Undisturbed for another 200 years, Northwest waters suddenly churned with activity. To head off Russians from the Aleutians, Spanish explorers Bruno Heceta and Juan de Bodega y Quadra landed on the Olympic coast and took possession for Spain—this in the year of Lexington, Concord, and Bunker Hill.

Three years later, Capt. James Cook sailed in. Aboard were two young men upon whom history's eye was cocked: William Bligh, later of *Bounty* fame, and George Vancouver. In 14 years Vancouver was to take possession, at a point in present-day Everett, for George III of England.

Later on their voyage, Cook's men discovered that Chinese mandarins would pay fabulous prices for the Northwest's sleek sea-otter skins. This touched off a scramble for furs and a collision of empires that almost brought Spain and England to war.

"Boston Man" Ran Three-way Trade

When the dust settled, Spain was out, and Indians bartered only with the "King George," as they called any Englishman, and the "Boston man," any American trader, explorer, or sailor. Yankee merchants fattened on a triangular trade: gimcrack peddler's wares to the Pacific Northwest, furs to Canton, teas and silks back to New England. A Boston captain, Robert Gray, discovered the Columbia and named it for his ship.

Lewis and Clark strengthened young America's aspirations when they reached the Columbia overland from St. Louis. "*Ocian in view! O! the joy,*" exclaims Clark's notebook on November 7, 1805.* And soon John Jacob Astor's short-lived Pacific Fur Company was contesting this rich realm with British trappers. First the sea otter, then the beaver ruled. London's fashion decree that gentlemen must wear hats of pressed beaver molded the destiny of the Northwest wilderness.

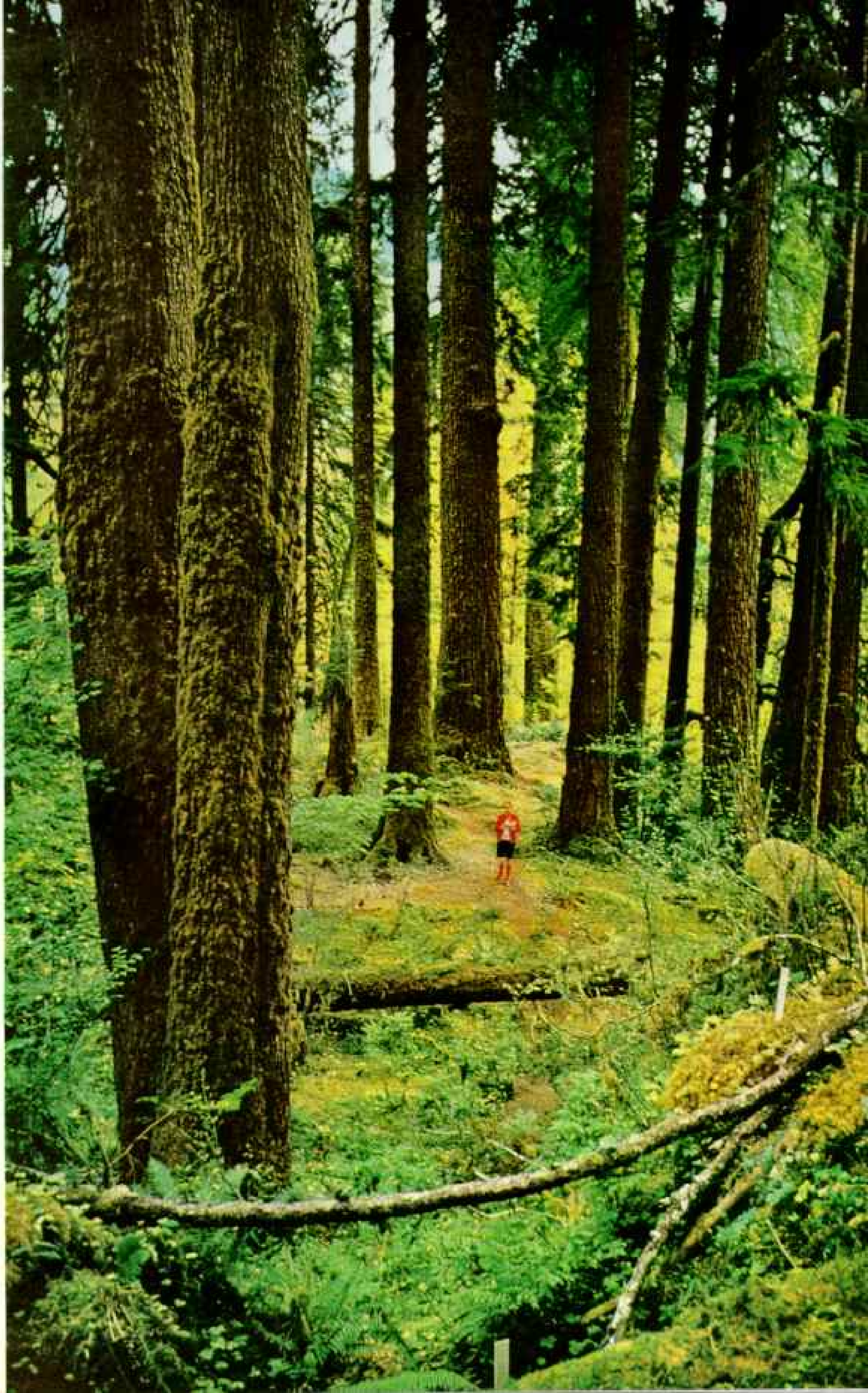
Years whirled by to the boisterous pulse of the fur trade, punctuated by the arrival of explorers and little bands of exhausted mis-

* See "Following the Trail of Lewis and Clark," by Ralph Gray, NATIONAL GEOGRAPHIC, June, 1953.

Moss Upholsters the Trunks of Spiring Conifers in Olympic Rain Forest

Moisture-laden Pacific winds dump 12 feet of rain a year on the Olympic Peninsula's western slopes, nurturing dense stands of western hemlock, Sitka spruce, western red cedar, and 200-foot-high Douglas fir. Ferns and shrubs carpet the floor of this cathedral-like forest in Olympic National Park. Only bird notes break the silence as the author's wife Pat strolls along a trail in the Hoh River Valley.

KODACHROME BY MERLE SEVERY, NATIONAL GEOGRAPHIC STAFF © N. G. S.



sionaries and settlers. Great Britain and the United States had agreed on joint occupancy, and the race was on. As early as 1838, settlers petitioned Congress to extend its jurisdiction over the region: "We flatter ourselves that we are the germ of a great state."

The Great Migration of 1843 fanned the Oregon Territory crisis to flame. The United States claimed a boundary near Prince Rupert in present-day Canada; England called the Columbia River the dividing line. The strident slogan "Fifty-four forty or fight" swept James K. Polk into the White House and both nations sent warships to the Columbia. But war was averted when, in 1846, the conflicting claims were compromised at 49°N.

Ambiguity in the treaty left the San Juans a two-man's land. This source of friction almost sparked a Pickett's charge four years before Gettysburg.

George Pickett, then an impetuous captain, stood ready for action as he defiantly blocked a British force from landing on San Juan Island. Calmer heads, however, prevented battle, and American and British camps were set up at opposite ends of the island. At the State Historical Society Museum in Tacoma, Director Bruce Le Roy showed me the gun that dispatched the near-war's only casualty —a pig. In 1872 the Emperor of Germany, as arbiter, ended the joint occupation (which had thawed into a round of banquets!) by awarding the archipelago to the United States.

To commemorate this peaceful solution, Washington's two Senators, Jackson and Warren G. Magnuson, have introduced a bill establishing a Pig War National Monument.

Besides Pickett, other officers destined for Civil War fame put in hitches in the Pacific Northwest: McClellan and Sheridan in Yakima Indian country; Ulysses S. Grant at Fort Vancouver, where he raised potatoes on the side. One figure was invited but never came: Abraham Lincoln declined the opportunity to be governor of Oregon Territory.

Apple Blossom Queen Inspects a Laden Bough

Washington, the leading apple State, grows a quarter of the Nation's crop.

Harvesting of Delicious apples, the most popular variety, runs from late September through October. Growers pick them just before maturity; cold storage completes the ripening.

Trees begin to bear five to eight years after planting and reach peak production in a quarter century. A large tree may yield 40 bushels.

Orchards surround Wenatchee, which calls itself the apple capital of the world. Beverly McKoin, queen of Wenatchee's 40th apple blossom festival, beams her pride over these perfectly formed Red Delicious apples, a dessert type marketed from coast to coast.

Cold fall nights bring out the healthy red color.

If Rails Won't Come to the City—

In the feverish 1870's and '80's dreams of a transcontinental railroad through Washington took on reality with the rails and spikes of brawling crews. But even the tracklayers played second fiddle to promoters in this era of financial high jinks and higher hopes.

The coveted prize was the tidewater terminal through which all the region's wealth supposedly would funnel. The most improbable villages lived in bubbling expectancy; citizens of several marched out with picnic baskets and laid a token mile of rails before giving up. When the Northern Pacific bypassed inland Yakima, outraged inhabitants put their town on rollers and moved it bodily four miles to where the city stands today—astride the rails. By public demand, saloons stayed open as they rolled across the sage.

To attract investors from as far off as Europe, promoters dreamed up whole paper cities of the projected terminals and spared no imagination on names and claims: Boston Harbor, Union City, Napoleon, mighty Frankfort-on-the-Columbia. I tracked down several of these mirages in western Washington, where the saying used to be: "We're as big as New York, only the town ain't built yet!"

Near the present village of Ocosta on Grays Harbor, I perused a brochure that lyricized another New York of the Pacific. It pictured elegant streets where stylish carriages moved past hotels, thriving businesses, and docks of "this remarkable city"—all amid a happy land where strawberries grow "10 inches in circumference" and coal comes in lumps "weighing 16,860 pounds!"

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

"They stuck trees in like telephone poles so they could say it was landscaped," white-haired Charles Nelson told me. "I was 16 then, a whistle boy in logging camps."

I looked out on lonely mud flats, about all that remained of Ocosta-by-the-Sea.

Port Townsend, long the customs port of entry for Puget Sound, also dreamed of greater things. But here the dreams took sturdy shape. Stone and brick buildings still stand in gingerbread array, awaiting crowds—and rails—that have never come.

Klondike Gold Sparks a Stampede

Tacoma won the prize. When transcontinental service began in July, 1887, Tacomans reveled three days. And as wheat poured in and lumber moved out, the city sprouted mills, elevators, new docks and warehouses, tripled in population, and in 1889 led all its neighbors on Puget Sound. That was the year Washington achieved statehood—and fires gutted Seattle, Spokane, Vancouver, and Ellensburg.

The cities rebuilt in solider stuff. And in 1893 the Great Northern Railway cut through the Cascades to Everett and Seattle, starting Seattle on a boom that, when Klondike gold poured in, became a virtual stampede.

Another stampede was under way in the tall timber. For this was the hungry era when lumber barons laid forests waste; when calked-boot bindle stiffs gypsied from one camp to another and left towns in shambles after their Saturday night sprees.

Today Washington's timber companies—Weyerhaeuser, Crown Zellerbach, Rayonier, and many others—practice conservation techniques, cut selectively, plant seedlings. And I've seen bunkhouses for burly loggers equipped with Beautyrest mattresses!

With Howard Curtis, general safety supervisor, I drove deep into the Olympic Peninsula to watch the Simpson Logging Company at work. West of Shelton we passed charred giants—reminders of 1902's ruinous fires—and saw wasteful, high-cut stumps of early days.

All over the State I had seen tree nurseries

(Continued on page 472)

Amateur botanists above Lake Chelan examine plants through pocket microscopes;

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

orchards of Delicious apples carpet the slopes. Glaciers gouged the lake bed long ago

Steel spider web arches 340 feet above Vance Creek. The Simpson Logging Company's train heads for Shelton, 14 miles away.

100 Feet Aloft With Saw and Ax, a High Rigger Climbs a Spar Tree

Trusting his life to climbing irons and a steel-cored safety rope, the lumberjack lops off limbs as he walks up the tree.

Trimmed, topped, and guyed to distant stumps, the giant becomes a spar tree, or living crane, that helps to drag its felled companions from a freshly cut area. Cables from an engine, passing through blocks atop the spar, lift the logs over stumps and other obstacles.

Boom boat and pond man sort logs for sawing into lumber, peeling for plywood, or pulping for paper. These logs await processing at the Weyerhaeuser Company's White River branch.

KODACHROMES BY E. ANTHONY STEWART (OPPOSITE AND UPPER) AND MELVILLE BELL GROSVENOR © N.G.S.

and heard the gospel of timber as a renewable crop. Here amid the rugged Olympics, open cuts alternated with blocks of green. Natural reseeding will mantle the clear cuts with 100-foot trees in 60 to 70 years. Meanwhile loggers harvest the mature blocks—never more than nature can replenish.

Tin Hat Wards Off Widow-makers

Whistle signals and snorting engines echoed among the ridges as we arrived at a "side" to watch a yarding operation. Curtis handed me a "tin hat" in case a "widow-maker"—a branch—should crash down from a 200-foot tree.

The yarder winched in logs on a steel cable reeved through a block on a distant spar tree (page 470). On the steep slope opposite, ant-sized rigging men worked amid a litter of matchsticks. The whistle punk pulled his cord, a diesel roared, and a matchstick came walking in across the canyon, growing in size to a giant trunk. The track loader snatched it up and slammed it on the bed of a truck. Relays of trucks switchbacked down the mountainside, transferred their loads to flatcars, and the huge Douglas fir, hemlock, and cedar logs clattered to the mill.

"A few years back, if anybody had said he could log a slope this steep, they'd have called him nuts," Curtis told me. "If we go any higher, we'll need mountain-goat teams."

After mail call at Camp Grisdale, the chow triangle clanged and a tidal wave of husky humanity poured into the mess hall. In a trice the loggers were seated, 32 to a table. Serving dishes whisked to and fro, and refills were rushed from the kitchen. No talk, just single-minded concentration on incredible amounts of food. I clocked the first man out at seven minutes flat. In 10 the mass exodus began. In 15 the hall was empty.

Appetites haven't changed. But the

Belching smokestacks tower above the Weyerhaeuser power plant at Longview. By burning sawdust and shavings, the plant generates electricity to help run three sawmills, a plywood plant, and other facilities. Most of the timber processed here comes from Weyerhaeuser's 500,000-acre St. Helens Tree Farm.

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

Women Weed Tomorrow's Forest Giants in a Nursery's Manicured Bed

Operated by the nonprofit Industrial Forestry Association, the Col. W. B. Greeley Forest Nursery at Nisqually each year grows 10 million seedlings for tree farmers. Hand planted, the baby trees assure regrowth on cutover land even if natural seeding fails. These year-old Douglas firs will be ready to cut in 40 to 80 years.

Indians Dress Salmon Steaks for Broiling Around a Bonfire

The Makah, who live on an Olympic Peninsula reservation facing the open Pacific, celebrate August 26 as Makah Day. On that date in 1925 they received full citizenship. Members of the tribe depend largely on the sea for a living. These women, cooking at a community potlatch, strap fillets between cedar stakes. Driven into the ground, other stakes ring the roaring fire.

fare certainly has changed from the days when a camp cook was known as a "belly robber." For 75 cents a man can eat all he wants. Some down two or three T-bone steaks, and at breakfast as many as 16 hot cakes plus eggs, ham, sausage, fruit, and a quart of milk.

Betty Badgley, one of the waitresses, invited me to see her home. Her husband Frank, whom I had watched operate the track loader that afternoon, earned $2.81 an hour; she got $2.15—more when "hoot owling" (predawn work). The Badgleys—they have two young daughters—paid $5.77 a week, including utilities, for their pleasant two-bedroom house.

"It's like living in town," Betty told me, "except that Frank is closer to the hunting he enjoys."

Bachelor loggers pay 20 cents a night for their

Wolf headdress carved from cedar adorns a Makah elder. His ancestry includes a great-grandfather renowned as a whale hunter. The Makah and other Nootkan tribes pursued whales in dugout canoes, often far from land. Paddling quietly up to their dozing prey, the hunters struck home with barbed harpoons. Wounded victims sometimes towed their assailants for days.

Eleven-man crews propel racing war canoes through Hale Passage in Puget Sound. The Lummi Stommish Water Carnival, held each June, attracts members of the Lummi tribe and northern neighbors. Several sports-filled days entertain Indians from a score of tribes, including many from Canada. Hollowed from cedar logs, the canoes sometimes measure 50 feet in length.

EKTACHROME BY KIM ARE (AN ARROW) (BELOW) KODACHROMES BY B. ANTHONY STEWART © N.G.S.

KODACHROMES © NATIONAL GEOGRAPHIC SOCIETY

Chief Eagle Seelatsee models the Plains Indian finery adopted by his Yakima forefathers in the 19th century. Catering to tourists, Indians of many tribes have standardized the Plains mode of dress.

Yakima Braves in Full Regalia Ride Single File to a Rodeo in Ellensburg

Once the tribe bartered horses with the Coast Indians in exchange for slaves. Normally peaceful, the Yakima held their own in a war against the U. S. Army and in 1856 joined in an unsuccessful attack on Seattle. Today some 4,500 Yakima live on a reservation west of Toppenish.

steam-heated, four-bed bunkhouses, made up and kept tidy by camp personnel.

I also visited the school in this model forest community, the barbershop, soda fountain, and recreation hall where movies, dances, skating, bowling, and Boy Scout meetings take place and first-aid courses are given.

As I returned to Shelton, night chill settled in the mountains, the moon shone cold, and deer vanished into foggy thickets along the road. But I felt warmed by my day at a company town that had a heart.

Following the logs to the mills, I heard a

screaming symphony of machines. At Everett whirring blades sliced logs into lumber. At Aberdeen a giant lathe unwound five-foot-thick peeler logs into endless ribbons of veneer for plywood. At Camas water jets under fantastic pressure blasted bark off; chippers chewed logs like celery stalks; chemical cookers digested chips into pulp that rolled from block-long machines as paper.

But that was not all. Where once a good part of the tree went up in smoke in a mill's burner, now one department's waste is another's raw material. Shavings turn into fiberboard or become fireplace logs; sander dust goes into linoleum. Meat packers proverbially use everything but the pig's squeal. Forest products men go them one better; they use even the tree's bark!

"Bark comes off the outside of plywood peeler logs and goes back inside the plywood as adhesive," my guide, Everett Barton, told me. We were touring the Weyerhaeuser Company's Longview plant, largest integrated forest products operation in the world (page

Charter Boats Jam Westport, King Salmon's Town

Last year anglers carried more than a hundred thousand king and silver salmon across these piers. Their catch comes from the entrance to Grays Harbor, where hundreds of boats bob on the tides when fish are running.

Boys clean the fish, some of which top 40 pounds, for 25 to 50 cents apiece. Anglers may leave their catch at canneries to be smoked, canned, or kippered, and then shipped home.

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

472). "Ground bark also goes into plastics, soil conditioners, and insecticides."

Pulp wastes are now being converted into alcohol and vanillin. "A tree is a bundle of cellulose fibers bound together by lignin," Barton explained. "What we do is take the tree apart and put it together again in a whole range of useful products."

Longview, a flourishing port on the Columbia, didn't exist 38 years ago. The dream of lumber magnate Robert Alexander Long, this city of broad avenues, fine parks, and handsome buildings is today the country's leading forest products center. But not even Mr. Long could have foreseen the Aerocar.

People still gape when a little coupe drives up, unfolds wings, and buzzes skyward. Longview's Moulton B. Taylor has been perfecting his Aerocar since 1948. Having won FAA approval, he has his sights on bringing the production-model price down to earth. When he does, Washingtonians will have another means of escape to their cherished out of doors.

A picnic or an expedition takes no urging in Washington. You run your car onto a ferry and tour the San Juans, or thread the unspoiled Hood Canal. Or you explore Long Beach, stretching 28 miles north from the mouth of the Columbia. Here you can beachcomb for Japanese fish-net floats, or prowl the skeletons of wrecked ships (page 455).

Many dig clams, as young dentist Bill Bigelow and his family do in Olympia.

Like so many Washingtonians, Bill is build-

KODACHROMES BY B. ANTHONY STEWART (ABOVE) AND BARRY BISHOP, NATIONAL GEOGRAPHIC STAFF © N.G.S.

Happy hikers pass Table Mountain in the Mount Baker recreation area. Joye and Brad Lucas of Ipswich, Massachusetts, wear dark glasses to ward off snow glare. Teddy hitches a ride in papa's pack.

Nisqually Glacier Wears a Crew Cut; Dripping Icicles Beard Its Face

Summer days swell the runoff from Rainier's 26 glaciers. Rivers that can be forded in the morning become torrents by afternoon. Water from this icy fortress feeds the Nisqually River below. Distant Mount St. Helens soars above the Tatoosh Range.

ing his own home. Outside his picture windows lies Puget Sound, and on a gravel bar near by the Bigelows often cook the shellfish they gather when the tide is low.

Tony Stewart, National Geographic's Chief Photographer, and I joined them one balmy August evening. The Bill Johnsons brought us over in a cabin cruiser.

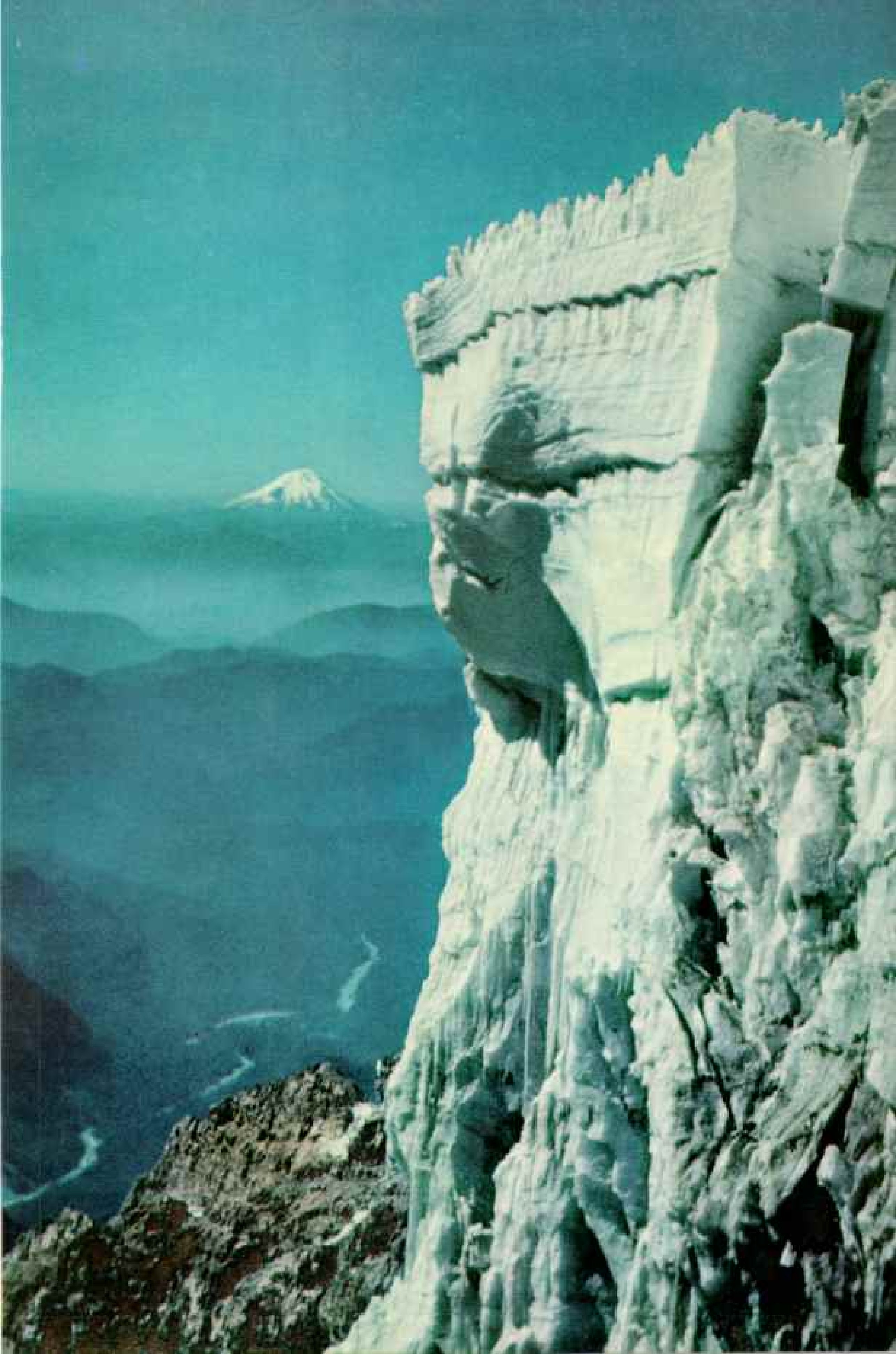
Soon there was the pleasant smell of driftwood burning. And while the girls busied themselves around the fire, the children romped. At dusk we fell to. Appetites quickened by delicious aromas, we feasted on steamed clams, baked oysters, broiled king salmon, cole slaw, and baked potatoes.

Afterward we lounged in stuffed contentment, singing around the campfire embers and looking out over glassy water that reflected a full moon. Tony and I were sold on outdoor living on Puget Sound—just as Northwesterners are sold on camping.

"We keep building and building campsites and facilities, and we never have enough," John Vanderzicht, State parks director, told me in Olympia. "Ten years ago we had 18,000 overnight campers. Our latest year's total was nearly 700,000. We're collecting every island we can get, so people can roam with boats and not worry about trespassing."

Vacationists flock not only to Washington's 55 State parks, but to its two national parks, eight national forests, and to campgrounds provided by timber companies on their lands.

Washingtonians would just as soon climb one of their mountains as look at it, especially if they can ski down it. What skiing they have! Mount Spokane, the Cascade passes, Hurricane Ridge, Mount Baker even holds



Exploding snow pursues a skier leaping a hummock in Mount Rainier National Park. Rainier's summit bulks at lower right.

Riders explore Rainier's flanks, where summer sun meets winter snow. St. Helens' volcanic cone rears in the distance.

Sunset tints curving dunes of snow at Paradise Inn. As much as 83 feet of snow has fallen in a single winter. Here 15-foot drifts reach the windows on the second floor.

 EKTACHROME (TOP) BY RAY ATKESON AND KODACHROME BY BOB AND IRA SPRING © N.G.S.

KODACHROME BY D. ANTHONY STEWART © N.G.S.

a ski tournament in early July. I left my own sitzmarks on its slopes in summer snow.

But all the area's mountains seem to pale before 14,410-foot Mount Rainier, Washington's most famous landmark.

The sign read "Paradise." The road wound up through forests of fir and hemlock, and I emerged in parkland on the shoulder of Rainier. And being on Rainier *is* paradise. Nothing I know can match the exhilaration of strolling its flowered meadows, riding its trails, crossing its snowfields to wonder at ice caves carved in its glaciers, or seeing its majesty mirrored in lofty lakes and pools.

One could stay on Rainier forever and never know all its moods. I saw it as a phantom, brooding behind swirling mists. I saw it radiant in sunlight, etched brittle and bold against the blue (page 484). I clawed along its slopes through fog so thick and dark you could carve your initials in it.

Rainier can test the mettle of any adventurer; it also offers gentler pleasures: meeting new friends on mountain trails, feeding chipmunks, or just basking in camaraderie before crackling fires at Paradise Inn.

"This mountain seems to hold something special for everyone," said Park Superintendent Preston Macy, my gracious mentor at Rainier.

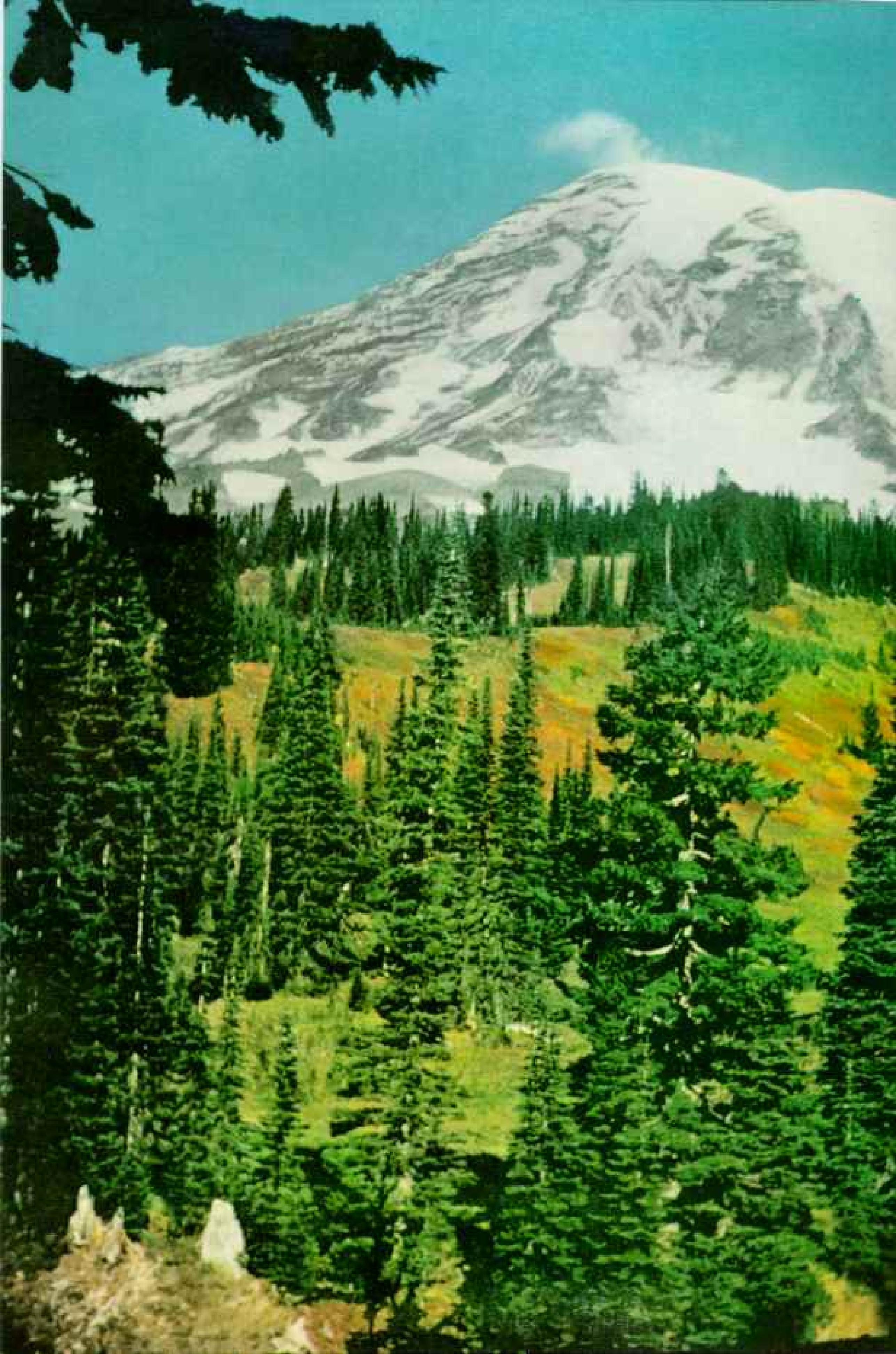
He might have been speaking of the whole State, for Washington's variety serves the tourist well. To commune with nature, seek the solitudes of Olympic National Park's rain forests (page 465).* If the weather socks in, pop over the Cascades to lake resorts in the sunny Columbia Basin. Or take the launch trip up the fiordlike reaches of Lake Chelan into the "Switzerland of America" (page 468).

Like a 49-mile-long dagger, Lake Chelan

* See "In the Gardens of Olympus," by Paul A. Zahl, NATIONAL GEOGRAPHIC, July, 1955.

Paradise Valley's mile-high parkland looks up to Rainier's glittering crystal dome

KODACHROME BY BERLE ADAMS, NATIONAL GEOGRAPHIC STAFF © N.G.S.



Spokane Treats the Inland Empire to an Outdoor Fashion Show

Ringed by mountains, the Inland Empire stretches from the Cascades to the Rockies. Spokane, hub of the vast region, serves as trade center for eastern Washington and parts of the surrounding States and Canada. Several stores in Spokane offer free delivery anywhere within the area.

These models, exhibiting fall fashions, parade beneath a canopy on Main Avenue.

drives into the heart of the northern Cascades, one of North America's wildest areas. Here amid raw and savage peaks, gleaming rivers of ice wind down into deep valleys; waterfalls plume into tiny emerald lakes.

I had heard about the fishing in these high Cascade lakes and flew in to look them over with Ernie Gibson of Chelan Airways. As we lifted out of Chelan's deep gorge, Glacier Peak gleamed in the sun, towering out of great green walls of forest. Distant Mount Baker poked above a tangle of snow spires.

I felt almost guilty about the vista—so rich a reward for so little effort! Somewhere below, I knew, my colleagues Kathleen Revis and Edwards Park were picking their way on horseback over plunging forested slopes, preparing a forthcoming NATIONAL GEOGRAPHIC article on this breath-taking wilderness area.

Derby Catch Canned at the Dock

We circled inside Horseshoe Basin and skimmed to a landing on mountain-girt Trapper Lake. The rumors were right, two campers from Wenatchee quickly confirmed. As we taxied over, one landed a 16-inch cutthroat trout. "If there's any place closer to heaven than this, I don't know about it," he said, displaying his bulging creel almost reverently.

Thousands of lakes lie strewn through Washington, and hatcheries stock the State's waters with as many as 50 million fish a year. Near Coulee City, anglers took 90,385 trout from Blue Lake alone one opening day!

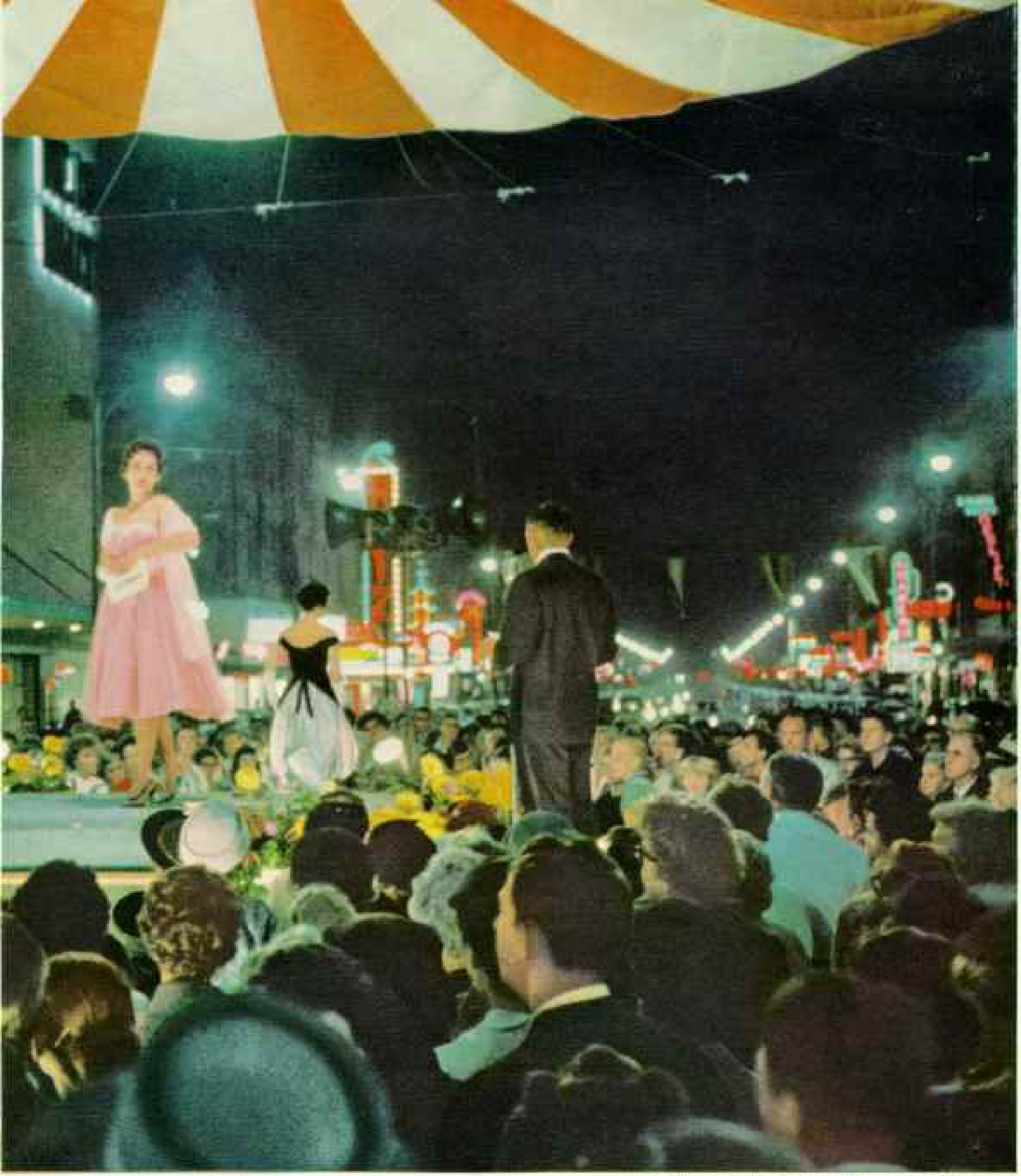
But while the fishing for rainbow, cutthroat, and the scrappy steelhead is great, Washington's pride is the salmon. In months when the five species head for their native rivers, it's hard to keep count of the salmon derbies.

My wife, Pat, and I decided we'd try our luck. At dawn one September Sunday we chugged out from Westport with seven other anglers (page 478). As far as the eye could see, scores of other boats crammed with fishermen bobbed on the swell over Grays Harbor bar. "If I were a salmon and saw this mob coming, I'd sure change my spawning habits," one of our companions observed.

I reeled in a flounder, a perfectly good fish. It was one of the bottom-fish crop that brings the State about $12,000,000 a year. But our skipper wrinkled his nose. "The only thing we call fish around here is salmon," he said.

Pat put me to shame, hooking three of the 135,000 salmon Westport tallied for the year. We had her 32 pounds of silvers canned right at the dock. Their pink meat has since graced many a Maryland meal.

I had seen salmon spawn in Wind River



HIGH SPEED EKTACHROME © NATIONAL GEOGRAPHIC SOCIETY

Canyon; I had watched counters at Bonneville, McNary, and The Dalles tick off salmon as they mounted the fish ladders bypassing these dams. But I hadn't expected to see "alumni" salmon stage a home-coming right on the University of Washington campus in Seattle.

Guiding these shenanigans is Prof. Lauren R. Donaldson of the university's College of Fisheries, oldest such school in the Nation.

I watched Dr. Donaldson and his students check in the alumni as they turned left from Lake Union, flipped up a fish ladder, and swung right through a gate into a concrete pool. Eggs from these arrivals would hatch, and the fingerlings, ventral fins clipped for identification, be released the following spring.

What homing instinct enables these fish to hit a 14-inch target—the fishway entrance—from far at sea? "Perhaps the sense of smell," Dr. Donaldson said. "Salmon develop a memory of the water where they were hatched."

The import of these experiments is tremendous. By establishing artificial spawning grounds in blocked streams, Washingtonians can have their dams and eat their fish too.

In wind tunnels scientists study the aero-

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

Twin Crowns of the Two Sisters Cap the Columbia's Gorge Near Wallula

A landmark on the east bank, this eroding butte stands 12 miles south of the Columbia's confluence with the Snake River. There Meriwether Lewis and William Clark, first American explorers to cross the continent, caught sight of the Columbia in 1805. Sacagawea, a Shoshoni Indian girl, helped the party through the Rockies.

dynamics of fish, to develop "ski jumps" over a dam. Ocean-bound fingerlings suffer high mortality passing through turbines and over roaring spillways. I saw a salmon tested on a "treadmill"—to learn how long he can battle a current—and other fish "steered" by lights (which they don't like) and electrical shock.

In an oceanography laboratory I met "the man who controls the rivers and regulates the tides." And before my startled eyes the waters of Puget Sound did rise and fall, rivers flooded, currents swirled, all in miniature.

"We can set this model for the tidal schedule of any season—or any year," Senior Oceanographer John Lincoln told me.

Lincoln pushed a button. Dye flowed in a river. This enables scientists to study currents and trace the paths of pollution, one of the biggest headaches of Washington's 30-million-dollar salmon industry.

Working together, British Columbia and Washington periodically close commercial fishing grounds to permit salmon to reach the spawning streams. And limits keep sport fishermen in check. Alone exempt from some regulations are Washington's Indian tribes, dependent on salmon since time out of mind.

The State has 45 tribes in all—12,000 strong—on 21 reservations. Just as the Cascades cleave Washington climatically, so were they a cultural divide for indigenous man. Indians on the east rode horses, lived as nomads, wore feathers. Coastal Indians dwelt in villages, got around by canoe, thought feather headdresses were for the birds.

Today the Yakima "long braids" of central Washington farm their fields and vacation by automobile, much as their white neighbors do. And in the coastal Indian villages, I found TV antennas atop the modest houses, kids in dungarees and T shirts riding bikes on paved streets. In picturesque Lapush, where Quileute men were cleaning nets, I spotted a cedar canoe named *Spaghetti*. In the Taholah home

of "Chief" Cleve Jackson, President of the Quinault Tribal Council, Mrs. Jackson told me about the PTA, women's club meetings, the school nurse program, the yard improvement campaign. On the wall a placard admonished: "The trouble with this tribe is that there are *too many chiefs and not enough Indians!*"

Spokane Rules an Inland Empire

Driving into Spokane, a handsome city of 190,000, I parked beside a car from British Columbia. Near by I spotted tags from Oregon, Idaho, and Montana. That's the thing about Spokane. It plays a big role as Washington's second city; but it's the undisputed star in the drama of the Inland Empire.

Roughly, this extends from the Cascades to the Rockies, from Canada's Selkirks to Oregon's Blue Mountains, and encompasses a million people. Nature strewed treasures around its rim: fruit, wheat, cattle, timber, the mineral wealth of Idaho's Coeur d'Alene region, Montana's mile-high Butte, and Washington's Metaline gulch that gave Spokane its heart of gold. In the middle of this empire—twice as big as Washington itself—sits Spokane, processing and shipping the region's raw materials. It is the largest city between Denver and the coastal centers.

Indians used to collect here to fish the Spokane River; fur traders set up shop in 1810. People have been coming and trading ever since: businessmen, housewives, loggers, farmers, cowpokes, miners. They savor "big city" sights, bank, shop, and play. For entertainment is a tradition in this home town of Bing Crosby and Patrice Munsel.

A city of homes, Spokane points proudly to 62 percent home ownership. And whether you live here or not, you feel welcome in this openhanded, country-fair kind of city. Airmen at Fairchild Air Force Base rate Spokane the country's friendliest town.

It has its sophisticated side, too, of fashion shows (page 486), Coliseum attractions, dining with a flair. At night the Ridpath Hotel Roof turns on a picture-window view of the city and some of the best beef you ever tasted. The Davenport Hotel, a proud Spokane landmark, carries on an elegant tradition: Silver coins are polished bright before coming to you in change.

Spokane sportsmen drive to the Pend Oreille country to hunt deer and bear, or fish in scattered lakes. Mount Spokane's chair lift is only 40 miles away; Riverside State Park, nine. Manito Park, Duncan Gardens, and fine golf courses all lie within city limits.

Spokane even has its own waterfall (whenever upstream floodgates permit). But not many know of its double-decked river. Mayor F. Gaines Sutherlin told me about it. An underground river parallels the surface river for about 30 miles. The result? Another of Washington's perpetual-motion machines: Hydroelectric power generated by the surface stream pumps spring-pure water from the subterranean stream into city mains.

South of Spokane, amid the deep-soiled Palouse country, rises Steptoe Butte, grandstand seat for one of the greatest agricultural shows on earth. Swirling fields of wheat roll away on every hand, textured with blocks of purple-brown earth, golden stubble, and deep-brown grain, where toylike combines cut patterns on the gentle hills (page 490). Wheat strains developed at Washington State University in near-by Pullman have helped put Washington at the top of the Nation in per-acre wheat yields.

Modern Pioneers Open New Lands

When I first entered the State, near Spokane, I was greeted by a sign that read: Opportunity. And as I traveled some 9,000 miles around the State, I came to feel that "opportunity" was the key to Washington after all. Nowhere did this strike home with more force than when I saw the miracles taking place in the heartland of the State.

"Most people think of Grand Coulee Dam only in terms of power," Philip Nalder told me as he took me up in a Cessna to look over one of the world's largest reclamation projects. "Grand Coulee's big story is in its waters that will bring life to more than a million acres."

As we banked low over the dam, Nalder, then manager of the Columbia Basin Project, explained that six of the largest pumps in the

Dusty Combines Attack a Golden Sea of Winter Wheat Near Walla Walla

Cake and pastry bakers favor flour milled from eastern Washington's soft white wheat. Bumper crops grow on the rolling hills; yields top 35 bushels an acre, the Nation's highest. Planted in the fall, the grain weathers the winter and ripens for harvest in July. Dark fields in the background usually lie fallow every other year.

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

HIGH SPEED RETACHROMES © NATIONAL GEOGRAPHIC SOCIETY

world lift the river's impounded waters 280 feet into a 27-mile-long equalizing reservoir. We flew the length of this bleak lava trench where the Columbia once flowed, and followed the irrigation water out into the canals that bring it to thirsty lands to the south.

"Here's phase one," Nalder said, and I looked down at a desolate expanse of sagebrush. Contractors' equipment still stood beside a newly completed canal.

"Phase two," he said a little farther on. Laterals branched off from the main canal, and here and there a ribbon of road and a block of green interrupted the barren waste. Water was being put on the land.

"Phase three," Nalder pointed. Below, paved roads laced together a fertile checkerboard of greens, dotted with farm buildings. Machines were working the fields.

Later I visited thriving towns that had grown with the Columbia Basin Project: Ephrata, Quincy, Moses Lake, Othello. I watched men harvest sugar beets, tend fields of corn, beans, and potatoes. And I met the families that had come from many States to make a new life, on new land, in Washington.*

History Turned at Walla Walla

With these present-day pioneers fresh in my memory, I ended my tour in Walla Walla, where in a way this had all begun.

Violence hardly seemed to keynote this pleasant city in southeastern Washington. Its tree-lined streets, Congregational Church, and the ivy-clad halls of Whitman College reminded me of a New England college town.

Yet this gentle, conservative community, going about the business of canning its peas and shipping its wheat, traces its rowdy roots to wagon-train and gold-rush days, when it was Washington's inland gateway. And six miles west occurred a tragic act that was to affect the course of Northwest history.

It was gently misting when I mounted the knoll at Waiilatpu, "the Place of Rye Grass." Here homesick Narcissa Whitman used to come at sundown to look back east and dream of the life she had given up to come to the salvation of "a dark-minded, wandering people"—the Cayuse Indians. Almost forgotten now was the ordeal of the Oregon Trail. She and a companion were the first women to endure that journey through the land of terrible distances, of dust, of wagons creaking ever on, of sparse meals cooked over stingy fires.

The mission Marcus and Narcissa Whitman built in the wilderness stood as a beacon, a haven for weary travelers who followed on the trail. But golden-haired Narcissa faced daily hardships and growing discouragement, particularly after she lost her only child.

Progress was slow, converts few. Attendance lagged at the school the Whitmans had established. "The Indians are roused a good deal at seeing so many emigrants," wrote Narcissa. There were threatening incidents.

Massacre Unveiled Northwest Promise

Then measles struck the Indian camp—a white man's sickness. Dr. Whitman's medicines were able to save white children, but not Indian children, who had no resistance to the disease. Rumors of poison spread, tension mounted. On the afternoon of November 29, 1847, the blow fell. Narcissa and Marcus Whitman and 12 companions at the mission died under the tomahawks and guns of the Indians; 47 others were taken captive.

The massacre shocked the Nation, and brought the protection of troops. But indirectly it held far greater significance. For it dramatized the fact that Narcissa Whitman had crossed the continent.

What she had done other women could do. The Pacific Northwest was not isolated after all. The land of the Columbia could mean homes, and wives, and children.

This was the force that made the land American. Instead of remaining the lonely realm of the Hudson's Bay trapper, the Northwest found its destiny in the families that came to put down roots and grow strong with the country.

In the Washington State of today I saw the pioneers' promise fulfilled—of days "when cities and villages shall spring up on the west . . . and a new empire shall be added to the kingdoms of the earth."

* See "From Sagebrush to Roses on the Columbia," by Leo A. Borah, NATIONAL GEOGRAPHIC, Nov., 1952.

All Fours off the Ground, Broncbuster Jolts His Rider at the Ellensburg Rodeo

To win prize money, a cowboy must remain astride his plunging steed for 10 seconds, keep both feet in the stirrups, and grip the rein with only one hand. Other contestants rope calves, bulldog steers, ride Brahman bulls, or milk wild cows.

Chess match in a cattle barn entertains 4-H Club youngsters waiting to show their livestock at the Southwest Washington Fair, sponsored by Centralia and Chehalis.

Snow-gemmed Mount Rainier hangs like a mirage over the towers of downtown Seattle;

A transplanted Easterner takes to her heart the vigorous, openhanded Queen City of the Northwest

Seattle, City of Two Voices

By ANNE GROSVENOR ROBINSON

Illustrations by National Geographic Chief Photographer B. ANTHONY STEWART

"WELL, WILL YOU LOOK at that!" The urgency of my husband's voice, cutting off a half-awake yawn, brought me quickly to his side. He had raised the shade of our bedroom window to let in the morning sun.

I blinked at the sight of a furry creature with a paddlelike tail, chewing contentedly on the sprouts of our willow tree. We stared in disbelief while our visitor—a full-grown beaver—munched several more shoots and then waddled into Lake Washington, whose waters lap at the foot of our lawn. His head left a tiny rippling wake as he swam off.

We had reason to be surprised: The beaver had breakfasted in the very heart of Seattle, Washington, where our home stands only three miles from a 42-story skyscraper. That building, in turn, overlooks the homes and work places of a million people.

I thought of our delightful, unexpected guest recently when, inspired by fondness for my

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

the ferry to Bremerton churns the waters of Elliott Bay, a gate to the Orient

adopted home, I sat down at my typewriter to describe the things I love about it. And the beaver, it seemed to me, offers a pretty good symbol of Seattle and its citizens: He is self-reliant; he makes wise use of what nature affords; he is at home on land and water.

Voices of the Mountains and the Sea

Ten years of Seattle are now in my blood, but I still can't take for granted the beauty of this city, built like Rome on seven hills. Its setting often brings to my mind lines from a Wordsworth poem:

> Two Voices are there; one is of the sea,
> One of the mountains; each a mighty Voice....

Two voices speak to me whenever I step from my front door, for my city is hemmed by water and walled by mountains. Westward lies Puget Sound, mighty inlet from the Pacific. Between sound and ocean the Olympic Mountains rear their snow-swept spine.

The eastern margin of the city dips into Lake Washington. Beyond these fresh waters rises the Cascade Range. The rounded summit of Mount Baker looms in the north. Southeastward stands the vast snowy dome of Mount Rainier, monarch of the range.

Constantly I meet some new and unexpected vista framed by trees and steep streets, or dramatized by sky and weather.

It may be a ferryboat barely visible in the shimmering, misty sound, or a venerable square-rigger moored at the waterfront. Or a double arch of multicolored light, as sun and showers play a game of rainbows across Lake Washington. Or a fresh view of the George Washington Memorial Bridge, vaulting across the canal dividing the city (map, page 500).

"The Queen City of the Northwest" could have won that title for her looks alone, but she dominates her region in many ways. With 600,000 dwellers inside her city limits, and half as many more near by, Seattle has no larger neighbor within 600 miles. A magnifi-

HIGH SPEED EKTACHROMES © NATIONAL GEOGRAPHIC SOCIETY

Seattle enjoys outdoor living. Few homes lie far from water; friends go visiting by boat. Barbecued hamburgers spice this potlatch, Northwestern version of a picnic. The author serves daughter Kippie and husband Dwight.

Picture-window view from the Robinsons' living room shows Lake Washington lapping their lawn. Guests' boats, one a racing sloop, moor at the pier. Seattleites, who share some 200 miles of shoreline, often commute by water.

cent harbor and 193 miles of waterfront have made her a great seaport, able to dock 90 ocean-going vessels at one time.

The salmon industry of the Northwest is centered here, as is the region's largest university, 16,800 students strong. Lumber from the vast forests of the Cascades pours through Seattle's mills and markets. And the giant Boeing Airplane Company makes the city a bustling capital of the new world of wings.

From my desk I look past our lawn, which stays emerald green the year around, to the expanse of Lake Washington. This lovely body of water stretches 18 miles north and south and averages two to three miles wide. Suburbs are swiftly outflanking it to the east.

Lake Washington is so deep—more than 200 feet in places—that bridge engineers didn't try to reach bottom with piers; they spanned its midsection on 25 huge concrete pontoons. From our dock we see this famous floating bridge, the largest structure afloat, as a low white barrier to the south (page 514).

Traffic on the lake is infinitely varied. A tanker slides by now, grizzled and rusted. Moments ago a sleek Navy launch cut her precise course for Sand Point. Several "flatties," small, beamy sailboats, scud in playful chase, piloted by children.

A tug, straining to move its ponderous tow of logs, blows its forthright whistle at a graceful cabin cruiser. Occasionally a stern-wheeler froths past, relic of another era, but no more out of place than the authentic Chinese junk, a private pleasure boat, that sweeps grandly by from time to time.

Fickle Weather Spices Life

Though we are only seven minutes from the bustle of the city center, many varieties of water birds swoop down beside our dock.

Ducks are so tame they trot up the stone steps to our lawn, quacking peremptorily for their handout of bread. In spring, when the mallards come by with their velvety ducklings strung out behind, my own baby, Grosvie, perches on the rocks and throws them tidbits.

Lake Washington weather is fickle. Morning waves may leap across our dock and crash in fury against our rocky bulkhead. Another day becalmed sailboats may be nodding gently in the glassy water. Fog sometimes shrouds the far shore so completely we look into nothingness and feel we are on a vast ocean.

All year round, as I go about my household tasks, the lake delights me. In any of nature's moods, a glimpse of its waters makes whatever I am doing seem easier.

Spring comes with soft, cool mists. The purr of a distant launch, the rhythmic "Stroke! stroke!" of the coxswain, and the swish of the long oars bring me running to the window. I hear the coach barking his commands, and I know that the University of Washington has begun crew practice. Suddenly the golden shells shoot out of the grayness and streak past me (page 507).

The shells are designed and built by a beloved Seattleite, George Pocock, a name known the world over. My husband, Dwight, speaks of Pocock almost reverently, for he rowed in Pocock shells at Yale and Henley.

Opening Day: Maritime Mardi Gras

One of the gayest festivals of our year comes with the first Saturday in May—Opening Day on Lake Washington (page 499).

Pleasure boats large and small, sail or motor powered, gather in Portage Bay, in the eight-mile waterway between Lake Washington and Puget Sound. Costumed friends shout gay greetings as the spruced-up boats cruise about. Balloons and flags festoon the rigging.

Once clear of the canal, entrants line up for the season's first sailboat race on Lake Washington. The darting, dipping sails are so thick it seems a swarm of white butterflies has settled on the water.

On Opening Day it's easy to believe that Seattle harbors 80,000 pleasure craft—more per capita than any other United States city.

In August comes the biggest water event of all, Seattle's Seafair. Ten throbbing days of pageantry and frolic roar to a climax in unlimited-class hydroplane races. Five hundred thousand boating fans jam Lake Washington's natural amphitheater for this finale, watching the rooster-tailed speedsters, their huge engines howling, half fly over the water at more than 100 miles an hour (page 502).

Warm weather opens endless avenues to recreation on the lake. Grosvie wades in the sandy-bottomed shallows. Kippie, our elder daughter, dives off the deep end of the dock, or skis behind the speedboat that will take us to a picnic in a favorite cove. Our guests, invited to a barbecue, arrive in a launch. Lake people commute to work, even go to football games, in their boats.

Through the summer, darkness brings cooling winds; we always sleep under a blanket. But even winter is kind. The temperature

never drops to zero, and snows are light and few.

Before Christmas the children and their friends are busy making holiday ornaments, but on one special evening the work has to be finished early. After a hasty dinner we must bundle up and be on the dock no later than 7:30.

"Here she comes!" one child shouts, and silence falls on the spellbound group as the proud Christmas Ship, strung with white lights, sails into view. Carols peal out from her deck, and presently our children are singing too, the glorious songs of Christmastide.

Smaller boats, some shooting fireworks, some ablaze with multicolored lights, sport in the big ship's wake. One, carrying Santa and his reindeer adorned with tinkling bells, always makes a friendly swoop toward our dock, and Santa doffs his hat to the children.

Sometimes I'm amused by the intensity of my loyalty to Seattle. After all, we've lived here barely a decade, and we are quite properly considered Johnny-come-latelies by fourth-generation Seattle friends.

Three years after the end of World War II Dwight was invited to join the faculty of the University of Washington Business School. We've never regretted the move.

University Outgrew Downtown Site

We still recall our first visit to the tree-shaded campus. The late Dean Howard Preston graciously welcomed us and led us past the varied architectural styles, predominantly Gothic (page 511). He stopped before four Grecian columns.

"These came from the original university which was established in 1861, 10 years after Seattle's founding," Dean Preston told us. "Within three decades the university had outgrown its downtown site and moved here."

The dean told us a story of the university's early days, illustrating its modest beginnings. When President Charles W. Eliot of Harvard visited the campus in 1892, he inquired about academic progress in the Northwest. Meeting Professor Orson B. Johnson, he asked what chair the professor occupied.

"I don't know what chair you would call it," was the reply. "I teach zoology, botany, physiology, physics, astronomy and . . ."

"You don't occupy a chair," interrupted President Eliot. "You occupy a settee."

Today the university faculty has grown to more than 1,300. One of its distinguished number is Pulitzer Prize-winning poet Theodore Roethke. Another Pulitzer Prize professor was Vernon Louis Parrington, author of the massive, scholarly study, *Main Currents in American Thought*.

The years have brought many changes since the days of Asa Mercer, who was the university's first and for a while its only teacher. Mercer used to tour the Puget Sound country in his canoe, trying to attract pupils by singing the praises of academic learning. He even persuaded some with the promise of jobs—cutting firewood at $1.50 a cord.

Teacher Recruited "Mercer Girls"

Apart from his scholastic efforts, there is another good reason why Mercer's name is remembered by Seattleites.

In the 1860's he looked about and observed that the town's population was mostly male—"almost wholly beyond the reach of female influence and its wholesome restraints." If the town was ever to amount to anything, Mercer decided, ladies must be imported.

Action followed thought. Resourceful Asa went to New England to persuade millworking maidens and Civil War widows to cast their lot with growing Seattle. Mercer met obstacles. He described the worst one:

"A few days before the time fixed for departure, a long, scurrilous article appeared in the *New York Herald*, slandering me, stating that all of the men on Puget Sound were rotten and profligate; that the girls would all be turned into houses of ill-fame, and appealing to them to stay at home. The old saying that a lie will travel a thousand miles while the truth is putting on its boots was true in this case. Everywhere the article was copied, and before I could get my references printed and counteract the calumny, two-thirds of the passengers had written me, enclosing the *Herald* article . . . and declined further consideration of the matter."

But perseverance paid, and Mercer brought 57 young ladies back. To greet the first of them, the town bachelors turned out "looking like grizzlies in store clothes and their hair slicked down like sea otters."

Affectionately known as the "Mercer Girls," the ladies quickly found homes, took up schoolteaching, dressmaking, and such. Most of them married and founded families.

The spirit of enterprise that animated Asa Mercer has fired Seattle folk since the day the first settlers stepped ashore at Alki Point.

A chill rain was falling on November 13,

ROB ROY THE SPRING

Parading Yachts, Gay With Pennants, Launch Seattle's Sailing Season

Hundreds of spectator craft crowd Portage Bay. Here, on Opening Day, the upraised arms of Montlake Bridge admit the 1959 fleet to Lake Washington.

SEATTLE
QUEEN CITY OF THE NORTHWEST
Puget Sound
Lake Washington
Eighty miles to Mount Baker, a year-round playground for Seattle folk
Sand Point Yacht Club ½ mile
Sand Point Country Club
Sand Point
U.S. Naval Air Station
Reservoir
Shilshole Breakwater
Shilshole Bay
Chittenden Locks
Fort Lawton
West Point
Salmon Bay
Ballard Bridge
BALLARD
West 65th Street
15th Avenue N.W.
Green Lake
Woodland Park
Aurora Avenue
Roosevelt Way
Ravenna Park
Sand Point Way
East 45th Street
Edmond Meany Hotel
University of Washington
Lake Washington Ship Canal
University Bridge
Fremont Bridge
Seattle Pacific College
Showboat Theatre
Union Bay
MAGNOLIA BLUFF
George Washington Memorial Bridge
Portage Bay
Montlake Bridge
Queen City Yacht Club
Seattle Yacht Club
Northeastern Overlook
Magnolia overlooks
QUEEN ANNE HILL
Lake Union
University of Washington Arboretum
Downtown Overlook
Alaskan Way
Volunteer Park
Seattle Art Museum
Author's Home
Seattle Tennis Club
Smith Cove
Civic Auditorium
Armory
CAPITOL HILL
East Madison Street
East Denny Way
Statue of Chief Seattle
Subway
DENNY REGRADE
Harry
FIRST HILL
Frederick & Nelson
Broadway
Seattle University
Elliott Bay
Pike Place Market
Northern Life Tower
Olympic Hotel
Madrona Park
1889 fire started here
Pioneer Square
Smith Tower
Yesler Way
Lake Washington is 22 feet higher than Elliott Bay, which lies at sea level
Corinthian Yacht Club
Duwamish Head
King Street Station
Union Station
U.S. Marine Hospital
Tunnel
Lake Washington Pontoon Bridge
Colman Park
Mercer Island
Site of the first Seattle settlement
West Seattle Overlook
Harbor Island
Alki Point
Alki Beach
Schmitz Park
1st Avenue
4th Avenue
BEACON HILL
Gold Cup Hydroplane Course
West Spokane Street
WEST SEATTLE
Jefferson Park
Lake Washington Park
Beach Drive
West Seattle Golf Course
Duwamish Waterway
Central Freeway (Under Construction)
RAINIER VALLEY
Seward Park
East Marginal Way
West Marginal Way
Airport Way
Rainier Avenue
The Olympic Mountains, 40 miles to the west, raise a jagged rampart beyond Puget Sound
Empire Way
HOLLY PARK
Beacon Avenue
Boeing Field
Lincoln Park
Boeing Airplane Company
Fauntleroy Avenue
Delridge Way
Renton Avenue
Rainier Yacht Club
City Limit
Snow-capped Mount Rainier sparkles in the sky 55 miles to the southeast
STATUTE MILES
Soundings in feet
©N.G.S.

1851, when the little Portland schooner *Exact* dropped anchor and two dozen nervy pioneers were rowed ashore, carrying only the barest essentials for survival.

A monument bearing the party's names—Denny, Boren, Low, Bell, and Terry—marks their landing place on the cape that projects into Puget Sound southwest of the present city center. Of the adults—the group included 12 children—only four were older than 30.

These were not glint-eyed speculators on the prowl for a quick dollar, but sober folk who had come across country, most of them from Illinois, to create a lasting community. They found what they wanted here on the eastern shore of Puget Sound. Abundant resources lay at hand—an incomparable harbor, vast tracts of timber, salmon-filled waters, good farmland, and a benign climate.

But that first day only a roofless cabin gave them welcome. The infant Rolland Denny, whose mother was too ill to nurse him, bawled loudly when offered clam juice—his chief nourishment until he was old enough to chew. But Rolland lived to see his wilderness home become a great metropolis.

The settlers optimistically named their tiny community "New York." With a wry touch of realism, they added the name "Alki," which means "by-and-by" in Indian jargon. That strip of shore, now part of West Seattle, bears the name Alki today.

Present Site Picked by Clothesline

The first winter at Alki was trying. Hundreds of Indians camped near by. Consumed with curiosity—and reeking of the fish and clams that were the mainstay of their diet—they barged into the cabins, handled the few but intriguing possessions, and generally got in the way. The tidy pioneer women feared to remonstrate; survival of the settlers depended on keeping peace with the tribesmen.

The Seattle newcomers were still settling in when the brig *Leonesa* appeared offshore. She was in search of lumber for San Francisco, facing a building boom in the wake of the California gold rush. The colonists, surrounded by stands of giant fir, contracted to supply it. In 16 working days, they cut 13,458 feet of timber. It was the birth of one of Seattle's principal industries.

Alki, however, was not the best site. Lumber for shipment had to be towed to water deep enough for a ship to anchor.

Borrowing Mary Denny's clothesline (a priceless treasure in those days), and using horseshoes for a weight, Denny, Bell, and Boren set out in a canoe to seek a better location. Success came when their rig showed deep water close to shore in what is now Elliott Bay. On February 15, 1852, most of the original colonists staked claims along the bay shore and back deep into the timber.

Chief Lent Name Reluctantly

One day soon after the move across the bay, two strangers arrived at the settlement. One was Seattle, chief of the Duwamish and Suquamish tribes. With him came a white man, Dr. David S. Maynard, whom the fledgling town would not soon forget.

It was not treating the sick that built "Doc" Maynard's reputation. Doc busied himself with other enterprises. He started a general store and the first hospital. His was the first venture into packing and shipping the local salmon.

Maynard was a lively character, regarded with affection by settlers and Indians alike. "He occasionally stimulated a little," as Arthur Denny delicately put it. After imbibing, Doc was likely to reduce the prices of his wares until he ended by giving them away.

It was Doc Maynard, the story goes, who proposed the name of his friend, Chief Seattle, for the new settlement. The chief objected, for fear that such use of his name would offend his spirit after death. But he was won over, and we regard it as fortunate. Otherwise our city might still be called—as the location was for a time—Duwamps!

Seattle is justly proud of what it has accomplished in a scant 100 years. Yet, despite today's comforts and conveniences, its people retain a certain spirit from the pioneer days: a devotion to the outdoors, a distaste for affectation and artificiality.

The life we lead keeps close to home. Like our neighbors', it is simple and casual. Daughter Kippie, a small express train when she trots off to school in the morning, is a slow local when she straggles home, with frequent way stops at the homes of friends. Even grown-up visiting tends toward the over-the-back-fence variety.

But if Seattle offers the neighborliness of a small town, it also provides the cultural and commercial advantages of a metropolis.

In minutes I can whisk my daughter downtown to the matinee of a touring ballet company or Broadway show. In winter, a bus

Like rocket sleds, hydroplanes roar across Lake Washington at more than 100 miles an hour,

 HIGH SPEED EKTACHROME (TOP) AND KODACHROMES BY MERLE SEVERY, NATIONAL GEOGRAPHIC STAFF © N.G.S.

The winner: *Maverick*, an entry from Lake Mead, Arizona-Nevada, outran the home-town entries in the 1959 Gold Cup race.

Powered by World War II fighter plane engines, the boats need only wings to fly. Drivers push speeds so high they risk catapulting into the air on the slightest swell.

Seafair royalty, King Neptune and his queen reign over a ten-day festival that annually attracts some half a million spectators. Events range from pageantry to high jinks, from regattas to chess.

Mock pirates interrupt Neptune's festive visit by burning his yacht and driving him back into the sea.

takes her off for a day of skiing. Afterward she can run over to the Seattle Tennis Club for a dip in the heated outdoor pool.

Some mornings I drive to the university with Dwight. Our route leads through the Arboretum, one of Seattle's superb parks.

The Arboretum's 250 acres are artfully planted with shrubs from all over the world. In spring the lawns are splashed with the pinks and whites of flowering cherries. Azaleas, camellias, and rhododendrons bloom in profusion, though the city lies as far north as St. John's, Newfoundland.

Seattle is a tantalizing place for one who likes to shop. Whatever we hanker for, whether it's an antique Sheraton table or a special imported cheese, there is a downtown shop that has it. The trouble is, I stumble on so many exquisite things I don't need!

For novel favors or unusual gifts, I stop in at Haru Hattori's Far East Contemporary shop (page 508). From the ceiling dangle bamboo cages of artificial birds, streamers of paper flowers, and fanciful gilded and be-whiskered animals. The walls glitter with schools of red, blue, and yellow paper fish. In Japan they are flown as kites from bamboo poles; here they make eye-catching party decorations.

One of Seattle's favorite family stores is Frederick & Nelson, which occupies almost an entire block. While Kippie is measured for school uniforms, I drop into the Designer Room for a look at the imports from Paris and Rome. A blond model slinks past, showing a sulphur-yellow peau de soie evening dress, elaborately folded, draped, and puffed.

"Just in from Christian Dior," the manager

tells me. I blink when he adds that the confection costs $595. It's fun to look, anyway.

Amid this elegance it's hard to conjure up the single room of a building on Front Street in which D. E. Frederick and Nels Nelson started their store—and lived—in 1890.

Once when Nelson returned from a day's buying, ready to drop into bed, he looked around and gasped:

"Where is the bed?"

"A customer liked it, so I sold it," Frederick said.

Nelson roared with laughter and remarked prophetically, "With you running the business we'll get along."

Seattle's most fantastic store, perhaps, is Ye Olde Curiosity Shop, a landmark of the whole Northwest. "Beats the Dickens" is its motto, and I'm sure Charles Dickens would have shared modern customers' amazement at the store's variety of oddments.

The windows are crammed with totem poles, dried rattlesnakes, Eskimo stone carvings, and even a duck-billed platypus. A bewildering array beckons me inside: dried fish, moose heads, mounted butterflies, and Oriental carvings; old bayonets, skulls, and Indian jewelry. There are jewelry boxes made from toucan beaks, the Lord's Prayer carved on a grain of rice, crustaceans called "whale lice," a petrified snail, and a six-foot Chinese beheading sword.

Like most Seattleites, we are essentially homebodies. But when I get tired of washing dishes, we are at no loss for places to dine.

Seafood? There is Ivar's Acres of Clams on a Puget Sound

Cigar store Indians, whale's jawbone, shrunken heads, and a ship model share space with a mummy at Ye Olde Curiosity Shop.

Preserved by the desert climate, the body of a slain man was found in Arizona in 1895. Moved to Seattle, his mummy still shows the gunshot wounds that caused death. Hair, mustache, and eyelashes remain intact.

The flintlock pistol in the hand of assistant manager Morris Hart has endured 170 years.

Ton of candy fills a bin at Frederick & Nelson, a Seattle department store.

HIGH SPEED EKTACHROME (TOP) AND KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

pier, where we can eat outside with a view of the city's bright red fireboat, or in a cavernous interior hung with fish nets, glass floats, and nautical flags.

My favorite dish is steamed clams from Puget Sound served with a cup of clam broth. But Ivar's is famous, too, for salmon, Dungeness crab, Alaska shrimp, and tiny Olympia oysters about the size of your little finger tip.

There are good places to eat close to the bustling Pike Place Market. If we go early, we can shop first, and pick up such delectables as pickled herring, fireweed honey, blood sausage, and home-baked bread.

Then we step into Morris Tacher's Turkish Restaurant and order grape leaves stuffed with seasoned chopped meat. Or we can try out

Lake Washington Canal: Chittenden Locks Lift Logs From Sea Level

Since 1916, the year of their completion, the locks have handled more than two million transits, ranging from merchantmen to a mother duck escorting her brood. At this point ocean shipping enters a fresh-water complex that includes Lakes Union and Washington, and Portage, Union, and Salmon Bays (map, page 500).

Here, where the canal broadens into Salmon Bay, freighters, fishing boats, tugs, and barges tie up at piers. Log booms feed near-by mills.

Distant freighter on Puget Sound lies 21 feet below the level of the lakes and bays.

Twelve-foot oars propel University of Washington racing shells across Union Bay. Coach with megaphone instructs his crews, who practice within sight of the university's 55,000-seat stadium. Their predecessors won two championships in the Olympic Games.

KODACHROME (TOP) AND HIGH SPEED EKTACHROME © N.G.S.

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

Diners' Legs Dangle in a Well Beneath the Table

Steaming sukiyaki and other Oriental dishes have won an enthusiastic clientele for Seattle's Bush Garden, one of the largest Japanese restaurants in the Nation.

Following the Japanese custom, patrons remove shoes, but some rebel against the customary cramped, legs-crossed position; hence the recess below floor level.

Kimonoed waitresses pour tea and serve soup in cherrywood bowls. Rice-paper screens and a Mount Fuji landscape decorate the room.

Fanciful fish kites, gay paper puffballs, and other novelties deck the Japanese specialty shop of Haru-Far East Contemporary, Inc.

Two Nisei students at the University of Washington opened the business in 1954. Ruth Bernstein holds a magenta tulip made of discarded nylon hose.

some Chinese dishes at the Athena, a spot with a past of Greek cuisine!

Canlis', famed for its view, tempts us with charcoal-broiled steaks. Built on a steep slope near the George Washington Memorial Bridge, Canlis' gives the sensation of being suspended in space (page 512). At night, through the slanted reflection-proof windows, a million city lights twinkle in panorama.

Seattle Started Theater-in-the-round

After dinner on a spring evening it's pleasant to head for the Showboat, which is part of the University of Washington's drama school. Built on pilings over Portage Bay, the theater is designed to look like a large boat. You board it up a gangplank.

The Penthouse offers another unusual setting. This theater-in-the-round on the college campus took its name from a penthouse atop the Edmond Meany Hotel, where Prof. Glenn Hughes, director of the university's School of Drama, staged his experimental plays with audience surrounding actors.

"After all, a real-life room has four walls," says Professor Hughes. "Our Penthouse was the modern world's first theater created for the arena technique. Now there are more than 200 of them in Europe and America."

Glenn's students produce and perform in both the Showboat and the Penthouse. Many have gone on to Broadway or Hollywood.

From a rise in Volunteer Park, a lovely white stone building looks over Puget Sound to the majestic Olympic Mountains beyond. Children love to come here to the superb Seattle Art Museum as much as we do. They frolic on the sculptured Ming-dynasty camels flanking the wide entrance steps, and on the rams from the 15th-century tomb of the Chinese Prince Kao Sui.

"We've tried to reflect in our collections and changing exhibits the whole sequence of mankind's artistic genius. We've gone in almost every direction known to man," says Dr. Richard E. Fuller, the museum's director. In 1933 he and his mother, Mrs. Eugene Fuller, donated this museum to the city, and through the years gave the Eugene Fuller Collection.

Its most popular treasure is the permanent collection of Chinese jade, which is especially rich in 17th- and 18th-century jades but extends back to at least the 12th century B.C.

But the museum's halls also display the contemporary art for which our city is renowned.

I have often wondered how it happened that Seattle became the center for the widely acclaimed "Northwest school" of painting.

"I think," says Dick Fuller, "that artists like Seattle for its setting, and for its independent spirit. Of course, Mark Tobey has been a strong influence since he came here in the twenties. He

Bronze temple bird, studded with tiny mirrors, arrives at the Seattle Art Museum from Thailand. Dr. Richard E. Fuller, president-director, and Mrs. Giacomo Pirzio-Biroli inspect this addition to an outstanding Oriental collection.

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

has always encouraged the independence of his fellow artists."

Dick did not have to remind me that Tobey recently won the Venice Biennale. The only other American ever to win a comparable Venetian prize was James McNeill Whistler.

A community sensitive to art is likely to be music minded, too. Our city has a wonderful symphony orchestra, conducted by Milton Katims. Enormously popular are its family neighborhood concerts that the symphony holds in schools, church halls, and movie theaters. Even the youngest children are welcome.

Dwight and I feel that someone should set to music the panorama of Seattle's past, perhaps in something like Rodgers and Hammerstein's *Oklahoma!* The inspiration is surely here in the rags-to-riches record of a few score years.

First, as in so many parts of the West, there was the Indian problem. In 1853 the Territory of Washington was officially cut loose from Oregon. One of Governor Isaac Stevens's first duties was to make treaties with the Indians to establish legal title to the settlers' claims. He assured the red men reserva-

University of Washington's Gothic Towers Cast Fluttering Images on Frosh Pond

Some 16,800 students make this 99-year-old school the largest in the Northwest. Atomic and oceanographic research centers and major new construction reflect its dynamic spirit. Administration Building at left, Library at center right, and Physics Hall surround these students.

Eastern dogwood thrives in the university's Arboretum, whose 250 acres nourish some 2,500 kinds of trees and shrubs. Director Brian O. Mulligan gathers autumn-hued dogwood leaves.

KODACHROME (ABOVE) AND HIGH SPEED EKTACHROME © NATIONAL GEOGRAPHIC SOCIETY

tion lands, cash payment, and various concessions and favors.

Chief Seattle and other Indian leaders saw the futility of resistance. They agreed to part with their tribal lands and move their peoples to reservations.

"And when the last red man shall have perished," Seattle said in a notable address, "and the memory of my tribe shall have become a myth among the white men, these shores will swarm with the invisible dead of my tribe. . . . At night when the streets of your cities and villages are silent and you think them deserted, they will throng with the returning hosts that once filled them and still love this beautiful land. The white man will never be alone."

Chief Seattle's words proved true prophecy,

for even today the presence of his people lingers on. We use the term "potlatch," the Indian's word for his ceremonial feasts, for our own picnics and parties. A "tillicum" is a friend, today as in times past. A 50-foot totem pole stands as a prominent landmark of Pioneer Square in downtown Seattle.

In the 1870's exciting news reached Seattle: The Northern Pacific planned to push its railroad through to Puget Sound. What more logical terminus, Seattleites thought, than their bustling community? Jubilation turned to chagrin with the announcement that a rival settlement, Tacoma, on Commencement Bay, had been selected instead.

The townspeople, undaunted, built their own railroad. The route they chose now forms a part of the Northern Pacific's trackage to Walla Walla, 220 miles away in Washington's fertile wheat belt. Today four great railroads serve Seattle.

By 1889 the population had climbed to 33,500. But the city had grown in a ramshackle way; so it was perhaps a blessing in disguise that a pot of glue boiled over in a paint shop downtown one warm day in June.

An Aerie for Diners: the Canlis' Restaurant

A critical palate and forthright tongue landed Peter Canlis (far left) in the restaurant business 19 years ago in Honolulu. When he complained about food served to him in a cafeteria, his piqued host invited him to take over the kitchen and do better. He did. That success prompted him to launch his own establishments, first in Honolulu, then in Seattle.

Mr. Canlis's guests dine on charcoal-broiled steaks amid glass-walled elegance above Lake Union. Often their vistas include snow-crowned Mount Baker and the Cascade Range.

A Japanese-American waitress serves hors d'oeuvres to author Anne Grosvenor Robinson and Dr. Robinson. Mrs. Canlis (standing) greets her guests.

Before nightfall the conflagration which had started so modestly consumed more than 64 acres of the business district. Miraculously, no life was lost, but factories, offices, warehouses, and wharves lay in ashes.

Seattle rebuilt itself, and when the steamer *Portland* arrived on June 17, 1897, carrying a "ton of gold" from the Yukon, a new boom began. Alaska-bound prospectors swarmed into town. They had to be fed, clothed, entertained, and outfitted for their quest. Steamers packed them aboard for the voyage north.

Ever since, Seattle has enjoyed a commercial advantage as a gateway city to Alaska. Its Alaska-Yukon-Pacific Exposition in 1909 turned the Nation's eyes toward the area, and its Century 21 Exposition, slated for 1962, boldly sets its sights on the future. The exposition's theme: man's role in the Space Age.

The waters around Alaska are now the principal arena of the United States salmon industry. The Seattle region, especially Salmon Bay, is home base for the Alaskan salmon fleet, and much of the fish is canned and marketed here. No gift we send East is more appreciatively received than a rosy king salmon, ordered fresh for air shipment from one of our immaculate waterfront fish markets.

Washed-down Hills Build Shore

Pinioned between Puget Sound and Lake Washington, Seattle long seemed limited in potential growth. Steep hills, for all their magnificent vistas, posed further problems to builders. But the operator of the first steam sawmill in the area unknowingly started a trend when he began dumping waste sawdust into Elliott Bay. Gradually the spongy shore evolved into land, expanding the city's site.

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

At the century's turn, enterprising city engineer Reginald H. Thomson mounted a frontal attack on the offending hills. Borrowing the hydraulic methods of Alaska's placer miners, he sluiced down the Jackson Street and Dearborn Street hills to gentler contours. The flushed-out earth furnished fill along the waterfront.

During 30 years of regrading, engineers moved 40 million cubic yards of earth, reclaiming more than 1,400 acres of tide flats. Some 2,000 acres also were built up in southwest Seattle, including the dense industrial area of Harbor Island.

Companies mushroomed with the land. Typical of their growth: the firm founded by William Boeing, a young businessman who got into aircraft building in a rented shed because he wanted a replacement for a plane damaged in a mishap. Now the facilities of the giant Boeing Airplane Company cover nearly 3,000 acres in Seattle and near-by Renton. And Boeing jets carry the onward-driving spirit of Seattle around the world.

When I'm weeding my garden, or sewing draperies for our lake-view windows, or walking young Grosvie to the end of our dock, the vibrancy and enterprise that closely surround us sometimes fade out of sight and mind.

But then a ketch tacks in the breeze, or the mailman delivers our tickets to the symphony concert. Or my eyes lift to the high, white spectacle of a test-hopping jet plane tracing contrails in the sky.

It is then that I feel an old—10 years old!—surge of pride and satisfaction in my adopted home. It comes to me afresh that life is sweet, and ever exciting, in Seattle.

KODACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER B. ANTHONY STEWART © N.G.S.

Floating Bridge: 100,000 Tons of Concrete and Steel Rest on Water

World's heaviest structure afloat, the 20-year-old span saves travelers on U. S. Highway 10 a 14-mile detour around Lake Washington, whose 200-foot depths and unstable floor made a conventional bridge unfeasible. Held by massive 65-ton anchors, the four-lane roadway sways less than an inch in rough weather. A retractile unit in the span permits passage of ocean vessels. This aerial view looks west from Mercer Island.

Changing Empire of the Northwest

THOMAS JEFFERSON thought there might still be long-haired, hook-tusked mammoths roaming there. And no wonder, for most of the far-off Northwest was about as mysterious to his contemporaries as the moon is to us.

President Jefferson sent Meriwether Lewis and William Clark to explore the headwaters of the Missouri, scale the Rockies, and bounce down the Columbia River in spray-lashed canoes. They found no mammoths, but a land rich and rugged beyond their imagining.

Even today there remains something magnificently wild about those five Northwestern States—Washington, Oregon, Idaho, Montana, and Wyoming. Their area is big enough to cover New England seven times over, but only 6,300,000 people live there—fewer than in New York City.

Yet these hardy Northwesterners cut a third of the Nation's saw timber; here hunters shoot half a million deer each season, and anglers catch some 25,000,000 fish a year. Engineers construct mighty missile bases, widen highways, build modern freeways, and put up huge hydroelectric dams as fast as New Yorkers build skyscrapers.

River Rages in Hells Canyon

Close-up views of the uncrowded, energetic life in the Northwest appear on the preceding pages, in articles on Washington State and Seattle. In addition, dramatic changes across the entire region are reflected in the freshly compiled Atlas Map of the **Northwestern United States,** sent to members of the National Geographic Society as a supplement to this issue of their magazine.*

Thus two new dams, Oxbow and Brownlee, span awesome Hells Canyon, which splits Idaho from Oregon. At its greatest depth, near He Devil Mountain, lava-rock walls drop 7,900 feet to the roaring Snake River—1,800 feet deeper than Grand Canyon.

Here, too, are famous dams built over the past 30 years: Fort Peck in Montana, Grand Coulee in Washington, and many more with long blue lakes behind them. Still another spectacular piece of dam building—this one strictly the work of nature—appears in the triangle Montana wedges between Idaho and Wyoming: Earthquake Lake, a 1,200-acre legacy of the great upheaval that wrenched the Rockies in 1959.†

National parks, shown with red stippled borders, dot the area. They include three of the Nation's largest: Yellowstone in Wyoming, Olympic in Washington, Glacier in Montana. Idaho lures hunters with 31,000 elk in the Clearwater Mountains alone, and skiers with the powdery snows of Sun Valley.

Great freeways, marked by dashed double lines in red, are now being constructed to fit into the new Interstate Highway System. Meanwhile concrete hardens into emplacements for intercontinental ballistic missiles at U. S. Air Force bases such as Fairchild, near Spokane, Washington, and Francis E. Warren, near Cheyenne, Wyoming.

Road Pierces Canadian Rockies

The new map also includes large portions of three Canadian provinces—British Columbia, Alberta, and Saskatchewan. Here progress is symbolized by the Trans-Canada Highway, now nearly completed. Roughly parallel to the Canada-U. S. border, it will lead motorists 4,500 miles from Pacific to Atlantic through some of the world's most impressive scenery.

But despite all that man has done in the Northwest, the land remains essentially as it was. Lewis and Clark, should they return, would find great stretches of their route completely unchanged—with grizzly bears and mountain sheep still ranging the Rockies, geese feeding in the coastal lagoons, and a great stillness over the dripping rain forests.

*This new map forms Plate 11 in The Society's Atlas Series. Since the series began in January, 1958, 16 uniform-sized Atlas Maps have been issued. The Northwest map is the sixth of eight that will cover the entire Union of 50 States.

To bind their maps, more than 225,000 members have ordered the convenient Atlas Folio, at $4.85. Single maps of the series, at 50¢ each, or a packet of the 14 maps issued in 1958 and 1959, at $5.50, may be ordered from the National Geographic Society, Dept. 39, Washington 6, D. C. A combination of map packet and folio is available at $9.95.

†See "The Night the Mountains Moved," by Samuel W. Matthews, NATIONAL GEOGRAPHIC, March, 1960.

A many-times-visitor to Angkor's ruins and keen student of Khmer culture, the author links his 35 years of research with remarkable paintings by Maurice Fiévet for an unusual *National Geographic* article—re-creating the daily life of this lost civilization. The talented artist's drawings underwent minute scrutiny for accuracy by Bernard Groslier and George Coedès, French scholars who have devoted years to unraveling Angkor's riddles. The contributions of these talented men, teamed on the following pages, provide a vivid portrait of a vanished people.—THE EDITOR.

Ornate Cambodian temples of Khmer god-kings—rivaling in richness anything wrought in stone—lose their veil of mystery

Angkor, Jewel of the Jungle

By W. ROBERT MOORE

Chief, Foreign Editorial Staff, National Geographic Magazine

Paintings by MAURICE FIÉVET; photographs by the author

FOR 400 YEARS the great stone city lay abandoned, burning and cracking in the tropical sun, lashed by monsoon rains. Where a million people had worked, sung, and prayed, only wild beasts and bats went about their quiet business. Snakes scraped across the stone terraces, and vines and trees choked the wide roads and spacious lakes. Inexorably, the jungle closed in.

A century ago, a French naturalist named Henri Mouhot, exploring in remote Cambodia, heard tales of a fabulous "lost city" in the jungle. Skeptical but curious, he persuaded a local missionary to guide him to it. They traveled first by canoe and then afoot. Finally, breaking through the bush, Mouhot saw the ruins of what we now know as Angkor.

Great stone temples stood strangled by vines. Massive gateways, carved walls, and ornate terraces lay overgrown by gigantic silk-cotton trees and tentacled banyans. But there were no people. Only the cries of birds disturbed the solitude as he prowled the tumbled stones and marveled at the eerie ruins.

Because it was so heavily overgrown, Mouhot could not realize at first the full magnificence of the metropolis he had come upon: scores of temples, miles of roads, an intricate network of canals, causeways, moats, and reservoirs.

What unknown people had built it? Why had they deserted it? When had they left?

When Mouhot, amazed and baffled, asked these questions of Cambodians living near by, they could tell him little.

"It is the work of Pra-Eun, the king of the angels," they would say; or "It is the work of the giants"; or even "It made itself."

Drum's *Poom-poom* Resounds in Ruins

When I went to Angkor last spring, for the seventh time, I found a scene quite different from what Mouhot saw. Much of the jungle growth—and much of the mystery—have been cleared away from the ruins. Today a good road leads north from Siem Reap, and visitors by thousands come to view the old city.

Modern Cambodians even come to worship in the old temples, during their New Year, in April. As I stood in one of the vast stone structures, watching the candle-bearing pilgrims and listening to the distant *poom-poom* of a native drum, I could almost forget that Angkor had ever been deserted.

But when I asked one weathered old pilgrim, "Who built it?" I got almost the same

Royal Cambodian court performers cast dancing shadows at the main gate to Angkor Wat

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answer Mouhot had received a century earlier:

"The gods," he answered. "Only the gods could do so much."

Yet little by little archeologists have solved most of Angkor's puzzles. We now know that the city was once the capital of the Khmer Empire, which dominated much of Southeast Asia for six centuries (see box, page 542). We call it Angkor Thom (which means simply "great city"); its original name was Yasodharapura.

No longer are the Khmers baffling figures. We have learned enough about them so that on the following pages artist Maurice Fiévet has been able to re-create their daily life in accurate, detailed paintings. He shows them at work, at worship, at play and pageantry.

Unlike Mouhot, we can see the Khmers as people: as fishers, farmers, builders, and warriors. Many of them dwelt, as do their present descendants, in thatch-roofed houses perched on stilts around the great lake Tonle Sap. From its silted waters they netted fish to go with their daily diet of rice.

They were, first of all, farmers, with rice their principal crop. Many of their religious rites revolved about agriculture. They held a feast for the plowing of the first sacred fur-

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row; a feast for the harvest of the first fruits; and a ceremonial "burning of the rice." They knew how to grow two, sometimes three, crops each year, using one of the most remarkable systems of irrigation the world has ever seen.

Their feats of hydraulic engineering were even more notable than the magnificent carved-stone temples they left behind. They threaded the country with countless basins, canals, ponds, moats, and reservoirs, tying them together into a complex network. Some of their canals, which served also as roads, ran arrow-straight for as much as 40 miles.

We know the Khmers as resourceful fight-

Cambodian Pilgrims Throng Angkor Wat, Shrine of Their Khmer Forebears

"Grander than anything left to us by Greece or Rome," wrote French naturalist Henri Mouhot a century ago when he first saw this massive temple choked by the jungle, its existence almost forgotten. Once the capital of Kambuja, kingdom of the Khmers, the ruined city of Angkor today attracts visitors from every corner of the globe. These Cambodian holidaymakers walk a causeway whose balustrades represent the fabulous *naga*, or cobra, of Hindu mythology. Chiseled decoration—a canvas on stone—covers the temple's surface. Lotus-bud spires top terraces.

ers, battling invading rivals with spears, powerful arrow-hurling ballistas, and ornately decorated elephants of war. One Chinese historian reported that the kingdom boasted 200,000 of these mounts for its cavalry.

We know them, too, as businessmen—trading kingfisher feathers, rhinoceros horn, and spices for Chinese lacquerware, parasols, and porcelains. And we can envision them in their leisure moments, amused by circuses of jugglers or absorbed in the gamble of a cockfight.

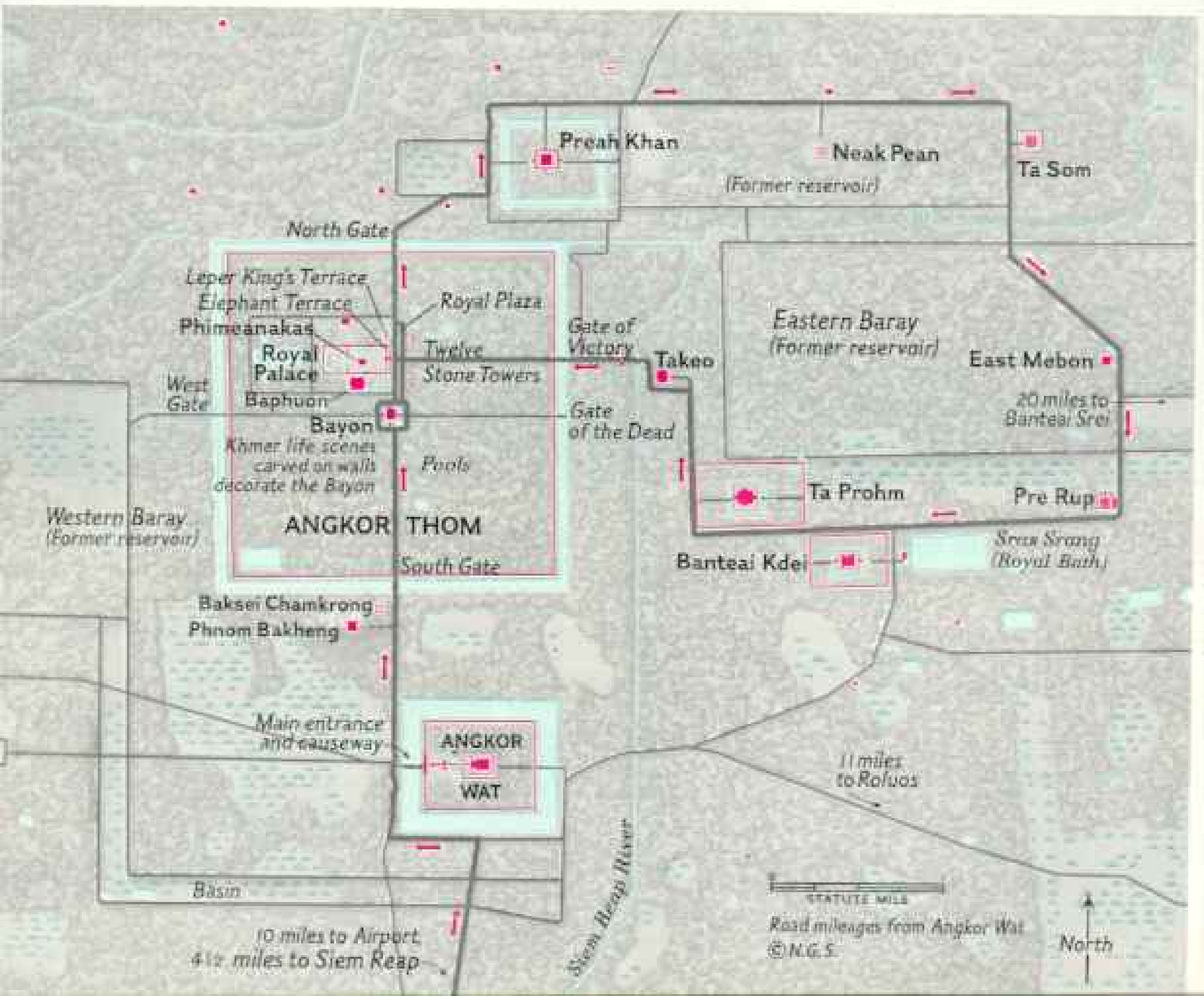
We obviously never will know their story as fully as we do those of civilizations that left behind a rich heritage of literature. The books of the Khmers, written on hides, palm leaves, and paper, long since have been destroyed by war, fire, termites, or the quick rot of the humid tropics. The royal palaces and many of the earlier Khmer shrines, built of wood, likewise have been reduced to mold or dust.

But one remarkable record—a series of warm, animated reliefs carved on the walls of a temple known as the Bayon—provided artist

(*Continued on page 524*)

Plan of Angkor: Follow the Red Arrows for a Self-guided Tour

Visitors get their first glimpse of Angkor Wat's soaring towers through a gap in the forest cut by the road from the town of Siem Reap. Following the temple moat, they come to the main, or western, entrance. Continuing north, they pass a 200-foot hill, Phnom Bakheng, on which Angkor's founder-king built his "mountain" temple. A short way beyond, they enter the south gate to walled Angkor Thom (great city), site of the Bayon, with its fascinating carvings and brooding stone faces. Temples and walls of the old palace quarter, fronted by the Elephant and Leper Terraces, spread to the north. A road north and east of the city walls leads visitors past other temples and extensive pools and irrigation reservoirs, some now dry, and brings them back to Angkor Thom. Map uses red to indicate temples and walls and blue to mark rivers and moats still holding water in season.



ALL PAINTINGS BY MAURICE FIÉVET © NATIONAL GEOGRAPHIC SOCIETY

That there should be in this country one sole sovereign

Royal chaplains reported the deification of the kings on a temple tablet now preserved in the National Museum, Bangkok.

Jayavarman II found his country forced to pay tribute to Java. In the year 802 he called upon a Brahman priest "skilled in magic science" to perform a ceremony that would lodge supreme authority in one divine king and declare Kambuja's independence. Artist Fiévet portrays the priest anointing the symbol of the Hindu god Siva in rites sanctifying Jayavarman (right) as *devaraja*, or god-king, and making it "impossible for this country of the Kambuja to pay allegiance to Java." For the next six centuries the Khmers dominated Southeast Asia.

Then His Majesty
. . . established the royal city

A temple inscription details the founding of Angkor, the Khmers' capital.

One of the first acts of Yasovarman I, the monarch who reigned half a century after Jayavarman II and founded Angkor, was the erection of a "mountain" temple atop a 200-foot hill called Phnom Bakheng (page 524). Artist Fiévet portrays the helmeted

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monarch, surrounded by his spearmen, priests, and umbrella bearers, standing atop the shrine and pointing to the site of the future royal palace. A straightened section of the Siem Reap River forms the eastern moat. The rectangular Eastern Baray, a four-mile-long irrigation reservoir, connects with the river; the king completed it in the first year of his reign. Later monarchs transformed Angkor into one of Asia's grandest cities, home of perhaps a million people. No trace of their wooden homes remains.

KODACHROME BY JOHN KASHIAN © NATIONAL GEOGRAPHIC SOCIETY

Cleared ruins of Phnom Bakheng, on which Yasovarman I built his temple, thrust above the forest. Angkor's south wall appears as a cleft in the jungle at upper right. Bush and rice cover the moat. Yasovarman's successors twice shifted Angkor's center, so that hill and shrine finally lay outside the city walls.

Octopuslike silk-cotton trees strangle and pry apart the sculptured stone galleries of Preah Khan, one of Angkor's 12th-century Buddhist shrines. Slowly, imperceptibly, pavements heave and walls topple.

Fiévet with contemporary scenes of everyday life, as real as action photographs.

For the history of the Khmers' rise, full flowering, and decline, we are indebted principally to French archeologists and scholars of the École Française d'Extrême-Orient, who stripped the jungle from many of the ruins and patiently sifted clues to their puzzles.

The native Khmer genius was sparked from its misty beginnings by traders and scholars from India. There developed an elaborate Indianized culture—particularly among the court and clergy—such as sprang up elsewhere in Southeast Asia and Indonesia. But the Khmers bent this culture to their own character and with deft chisels reshaped its art to one distinctively their own.

Oddly, most of our knowledge of the early Khmers comes from Chinese chronicles. About the beginning of the Christian Era the Khmers emerged in two separate states, which the Chinese called Funan, located in the lower Mekong River delta, and Chenla, farther inland (painting, page 526).

"The men are all ugly and black. Their hair is curly. They go naked and barefoot," states one 3d-century Chinese report on Funan. Later dynastic records, however, relate: "The sons of the well-to-do families [wear] sarongs of brocade. . . . The people of Funan make rings and bracelets of gold and vessels of silver."

Many Chinese trading and diplomatic missions visited Funan, and even in those days cultural exchange occurred. In the third century the Funan king dispatched a troupe of musicians to China, where they fascinated Emperor Sun Ch'uan with their odd music.

Angkor Wat Climaxed Khmer Art

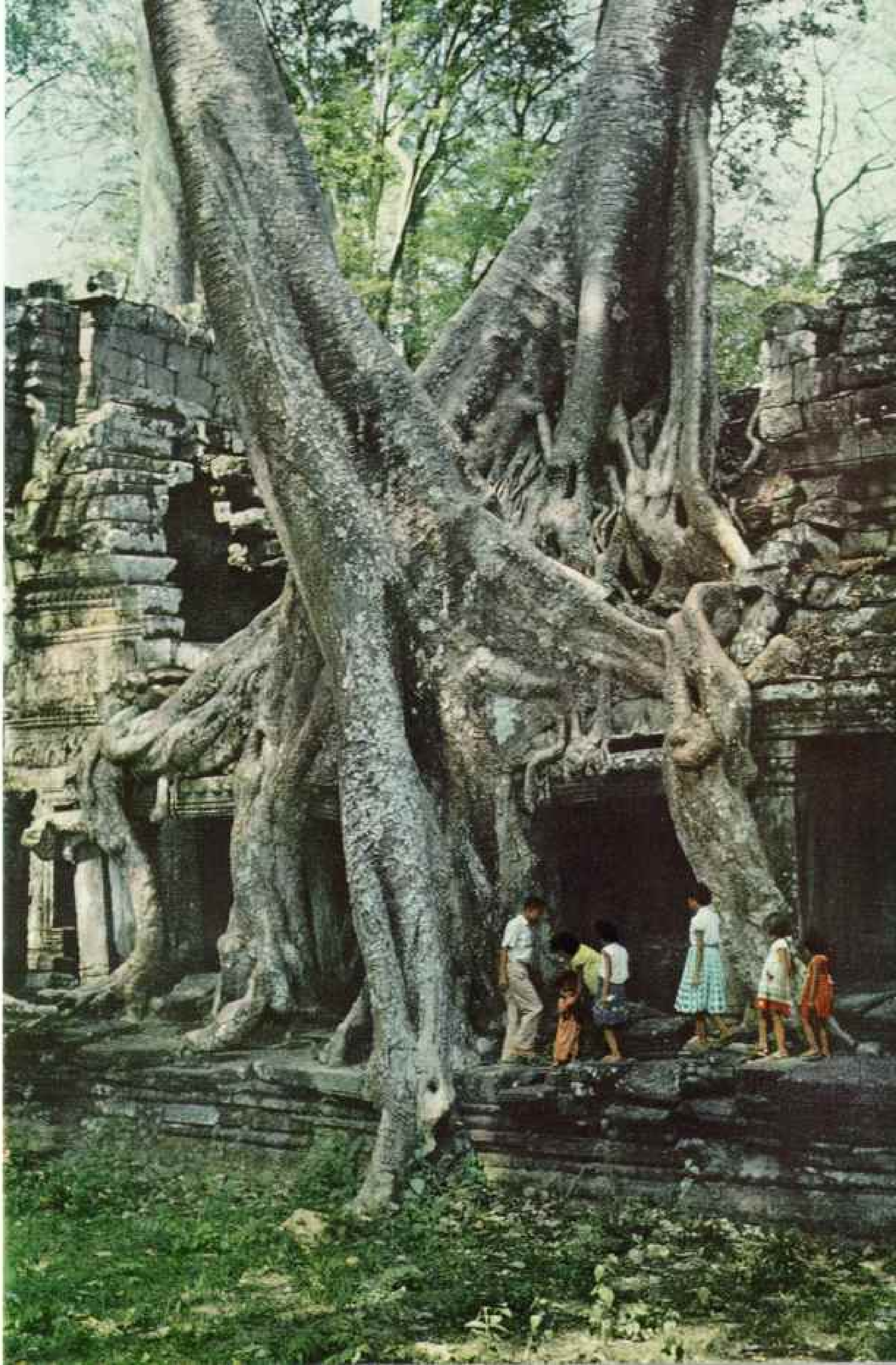
About the middle of the 6th century the inland kingdom of Chenla absorbed its delta neighbor, Funan, to form a single state—Kambuja, or Kambujadesa, whence the Western adaptation, Cambodia.

Then, two centuries later, began the so-called Angkorean period of the Khmers. It was to flourish under more than 30 monarchs for 600 years, climaxed by the architectural grandeur of Angkor Thom and Angkor Wat (city temple). Abandonment followed a destructive attack by the Thai in 1431, and Angkor was left to the ravages of the jungle for more than four centuries, to await the excited gaze of Henri Mouhot.

Today Angkor no longer lies tangled in jungle isolation. Roads afford access to the principal shrines. The Grand Hotel at Siem Reap, closest town to the ruins, even runs bus tours on "grand" and "petit" circuits.

As is inevitable, too, vendors cluster at the ruins. They sell postcards and guidebooks and tempt visitors with perforated buffalo-hide lampshades, crossbows, knives, and other souvenirs. A few offer Cambodian riels for

(*Continued on page 533*)



Modern Cambodia and parts of Malaya, Thailand, Laos, and North and South Viet Nam share the medieval Khmers' vanished realm.

Cambodian fishermen pole the shallows of the Tonle Sap, the Great Lake, and dwell in stilted thatch huts like those of their Khmer ancestors.

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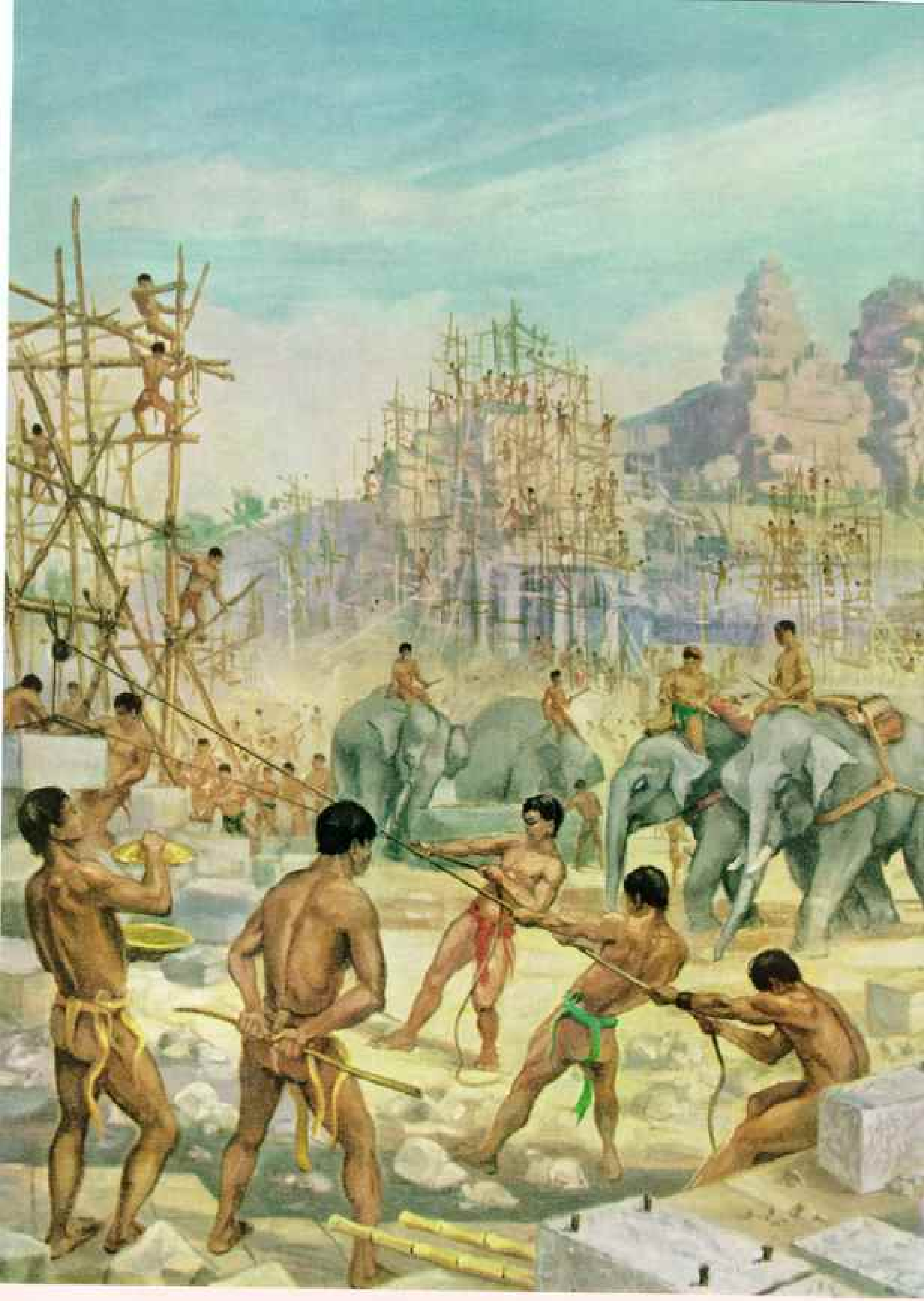
There exist many kinds of fish . . . in the Great Lake

Chou Ta-kuan, a Chinese commercial attaché, crossed the lake on arriving at Angkor in 1296. He left a description of its oddities.

Tonle Sap, Cambodia's sprawling "sea of sweet water," is one of the world's natural wonders—a reversible reservoir-lake. During the flood season, from June to November, the rain-swollen Mekong overflows into the lake through a broad channel that meets the river at Phnom Penh (see map). Waters rise to a height of 45 to 50 feet, inundate marshes, and create a natural aquarium. When the Mekong drops in the dry season, the flow reverses, and the lake shrinks to a depth of less than five feet.

To grow rice, the Khmers diked and canalized the flood plains that stretch in all directions from Tonle Sap. River, lake, and a network of canals served them as highways.

Artist Fiévet depicts 10th-century Khmers scooping basketfuls of fish into a boat from a pole trap set in the Tonle Sap. He could have drawn the scene from life today. His map locates Funan, the Khmers' earliest kingdom, and Champa, a rival state with which they fought numerous battles.



Elephant Teams Drag Heavy Stones for the Building of Angkor Wat

Artist Fiévet, copying details sculptured on the Bayon, depicts a generation's task. Two laborers in foreground drill holes into which they set

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pegs for handling. Crew at right slides a block back and forth, grinding surfaces until they fit without mortar; man atop the frame wets a strap to reduce friction. Gang at left uses rope and pulley to lift a stone. Men on distant scaffolds complete the lower gallery.

His Majesty (Suryavarman II) gave orders to the royal artisans. They erected towers, dug basins

An inscription dedicated to a Khmer priest who served three kings, including Suryavarman II, describes the calling up of labor battalions for regal projects.

Khmer sculptors transformed the walls of Angkor Wat's half-mile-long lower cloister into an unbroken picture gallery. Many of their carvings portray scenes from the Indian classics and holy texts. But one historical panel shows two portraits of Suryavarman, the temple's builder. In one he sits in audience with his ministers (page 536). The second shows him in an elephant parade with his chieftains, all of whom are named.

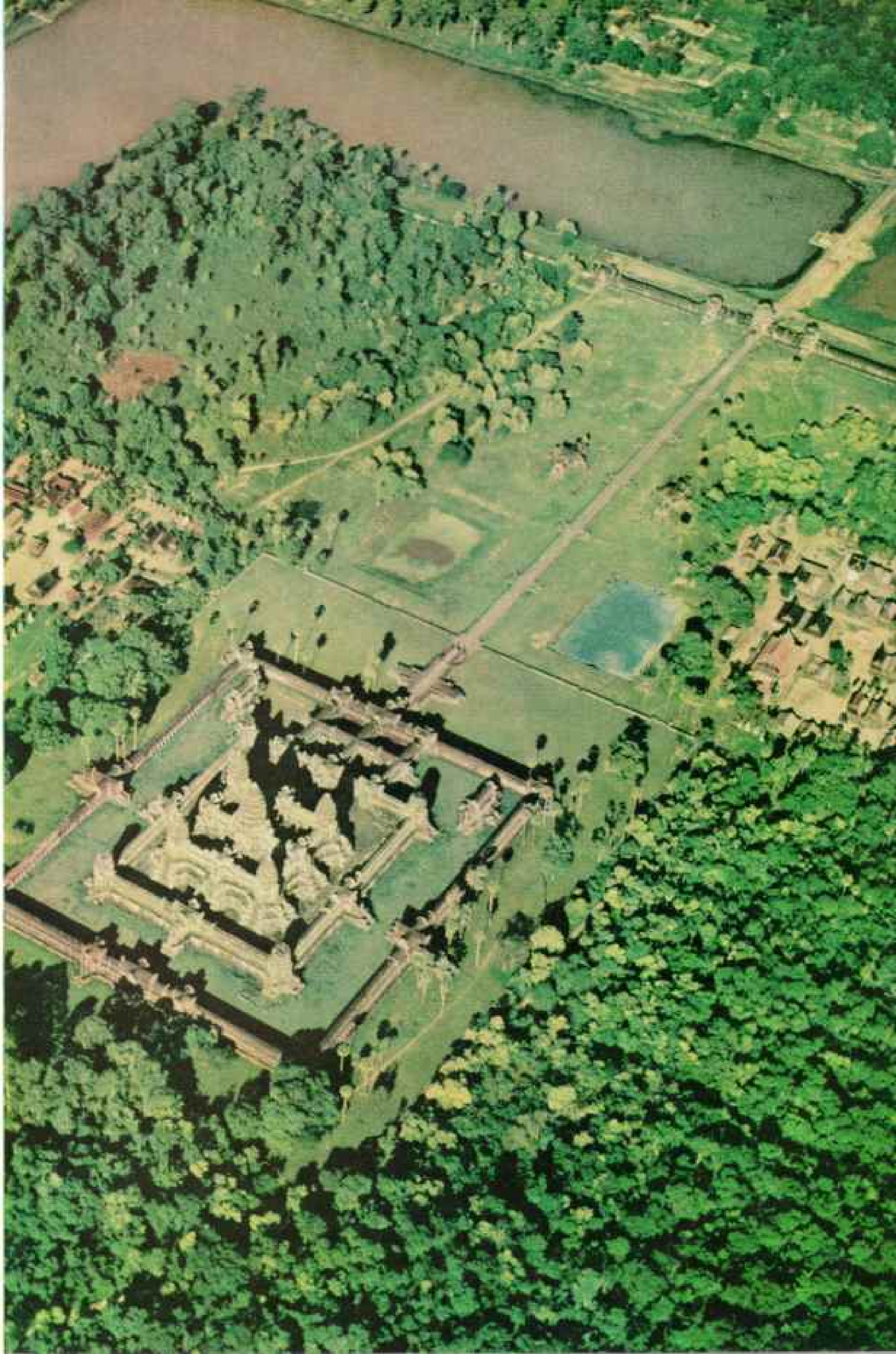
Suryavarman was anointed king in the year 1113 and crowned six years later. He resumed diplomatic relations with China, ending an interruption of three centuries, and waged wars against Annam and Champa. But his immortality rests on having built Angkor Wat, culminating masterpiece of the Khmer capital.

Angkor Wat is a classic temple-mountain, as were other Khmer shrines. Unlike a Western cathedral, it was designed not to accommodate large audiences but to be a symbolic abode of the gods and a funerary temple for the king's ashes when he "ascended to the gods."

Like the New World's Maya Indians, the Khmers never developed the keystone arch. Instead, they employed the corbel—flat stone upon flat stone.

Seen from the air, Angkor Wat reveals its remarkable symmetry. Wall and 200-yard-wide moat hem the temple grounds. Causeway at upper right crosses the moat to the main gate (page 516). The two enclaves of small buildings are Buddhist monasteries erected in modern times. Trees overgrew all the grounds before archeologists cleared them.

KENNETH GOODLIER © NATIONAL GEOGRAPHIC SOCIETY



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Sparkling with the fire thrown by the gems of her jewels

An inscription in the Temple of Ban Theat
describes the brilliance of a royal lady.

"In general, the women, as well as the men, wear a bit of cloth about their loins leaving their breasts, white as milk, uncovered," wrote Chou Ta-kuan. "They wear the chignon and go barefooted. This is so even of the king's wives."

Artist Fiévet, basing his painting on Chinese accounts, temple reliefs, and inscriptions, gives us a peep into the palace as a princess prepares her elaborate toilet. Swaying fans cool her while a harpist entertains. Other attendants adorn her with bracelets, arm bands, and jeweled neckpiece. Vials on her dressing table hold perfumes; bowls contain betel nut for chewing. The hand mirror is a polished bronze reflector. Royal ladies in the Khmer courts became astrologers, Sanskrit scholars, and even jurists.

U. S. dollars at black-market rates. "A more 'rielistic' exchange," I heard one tourist pun on my last visit.

I went first to Angkor Wat, as had Mouhot a century ago and as do most visitors now, because of its nearness to Siem Reap.

"... A rival to that of Solomon, and erected by some ancient Michael Angelo ... grander than anything left to us by Greece or Rome," Mouhot wrote of the temple.

Temple Stands as Mountain of Stone

Indeed, Angkor Wat, built in the first half of the 12th century, stands as the masterpiece of classic Khmer art. All the groping, growth, and elaboration of religious architecture by the Khmer kings through the centuries here found its ultimate expression, both in massiveness and in ornamental detail.

Yet one's first view through the road notch in the forest gives little clue to the size of this great temple. Even when I reached its encircling moat, the stone towers seemed small, far away.

And no wonder. The moat and outer wall embrace a rectangle of approximately a mile on each side—space enough for a sizable city. The moat itself is more than 200 yards wide. The triple-towered gateway across the causeway at the main entrance appears like an impressive temple in itself.

As I walked the nearly quarter-mile-long elevated stone pathway to the main shrine, it seemed to grow taller, more powerful, more majestic. And when I had entered the first gallery, climbed the steps to the second terrace, and scrambled up the precipitous stone stairway to the third, its five lotus-bud towers still soared high above my head.

Yes, Angkor Wat is a mountain of stone, but a mountain of remarkable plan—a triple-terraced, rectangular mountain, surrounded by galleries and cruciform courts, and surmounted by the five towering peaks.

Actually, according to Khmer symbolism, the temple *was* a mountain—the representation of mythological Mount Meru, atop which dwelt the gods of the Hindu pantheon. With these gods the Khmer monarchs, as *devarajas*, or god-kings, associated themselves.

Most Khmer kings chose Siva as their principal deity, but Suryavarman II, builder of Angkor Wat, worshiped the god Vishnu. And here in the holy of holies, within the base of the central tower, he installed a statue of Vishnu. And with it he identified himself as god-king. The temple thus stands as Suryavarman II's magnificent effort to honor his god and at the same time honor himself. All evidence indicates he erected it as his funerary shrine.

In sheer mass alone, its construction was a colossal undertaking. But grinding and fitting its stones was only part of the labor.

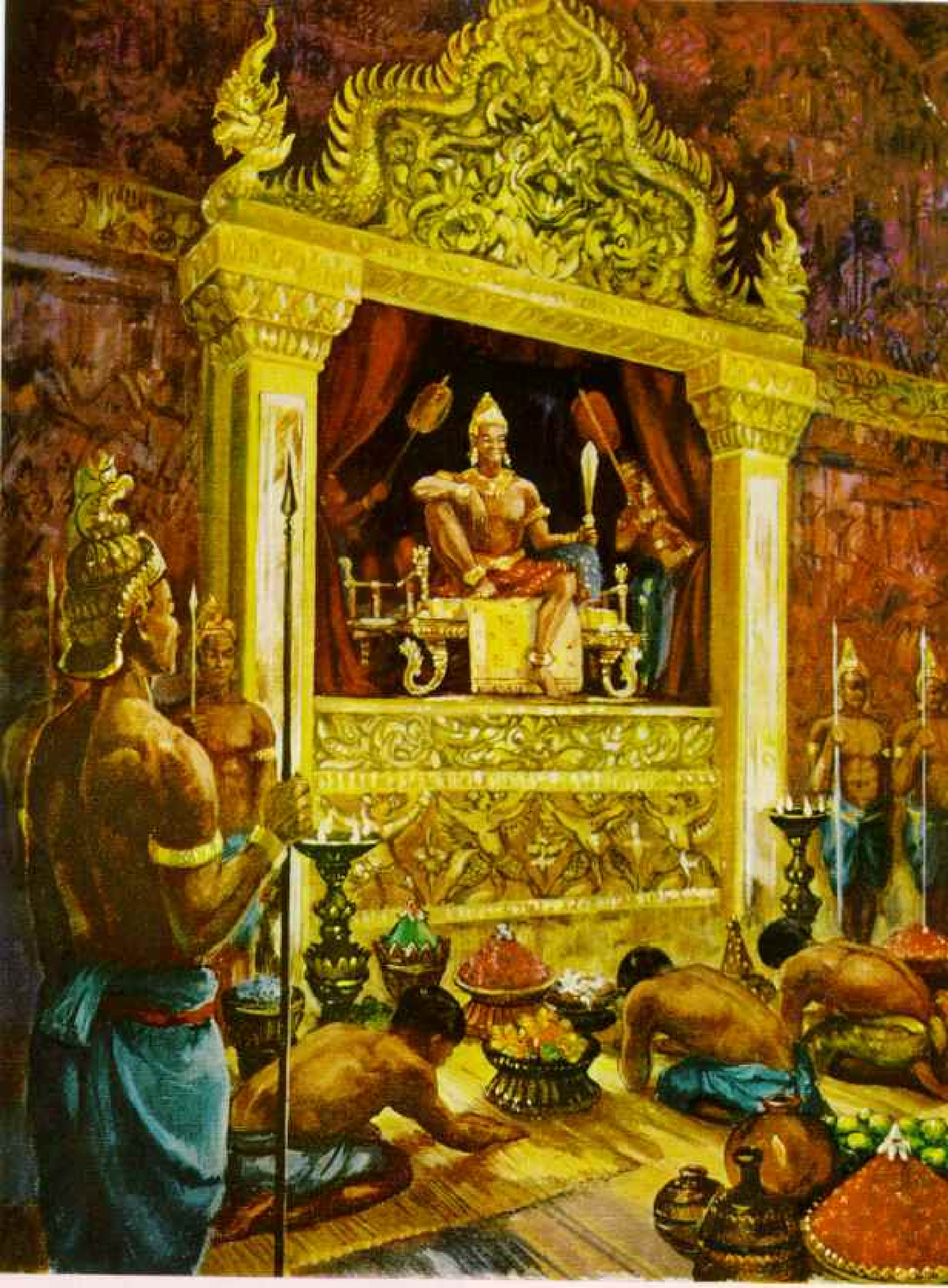
Artists chiseled virtually its entire surface with decoration. Some areas bear only a light over-all design, the tracery so delicate that you almost have to touch it to know it is there. Elsewhere decoration bursts forth with compelling vigor. *Devatas* and *apsarases*, or heavenly beings, singly, in pairs, and in whole bevies, seem ready to step into life from walls and pillars (below and page 557).

To see the sculptors' most ambitious work—and to escape the blazing tropic sun—I sought the shaded cloisters of the lower gallery. Its outer side is open, supported by twin rows of columns; its inner solid wall is a half-mile-long canvas of stone.

Upon it rage eternal battles between gods

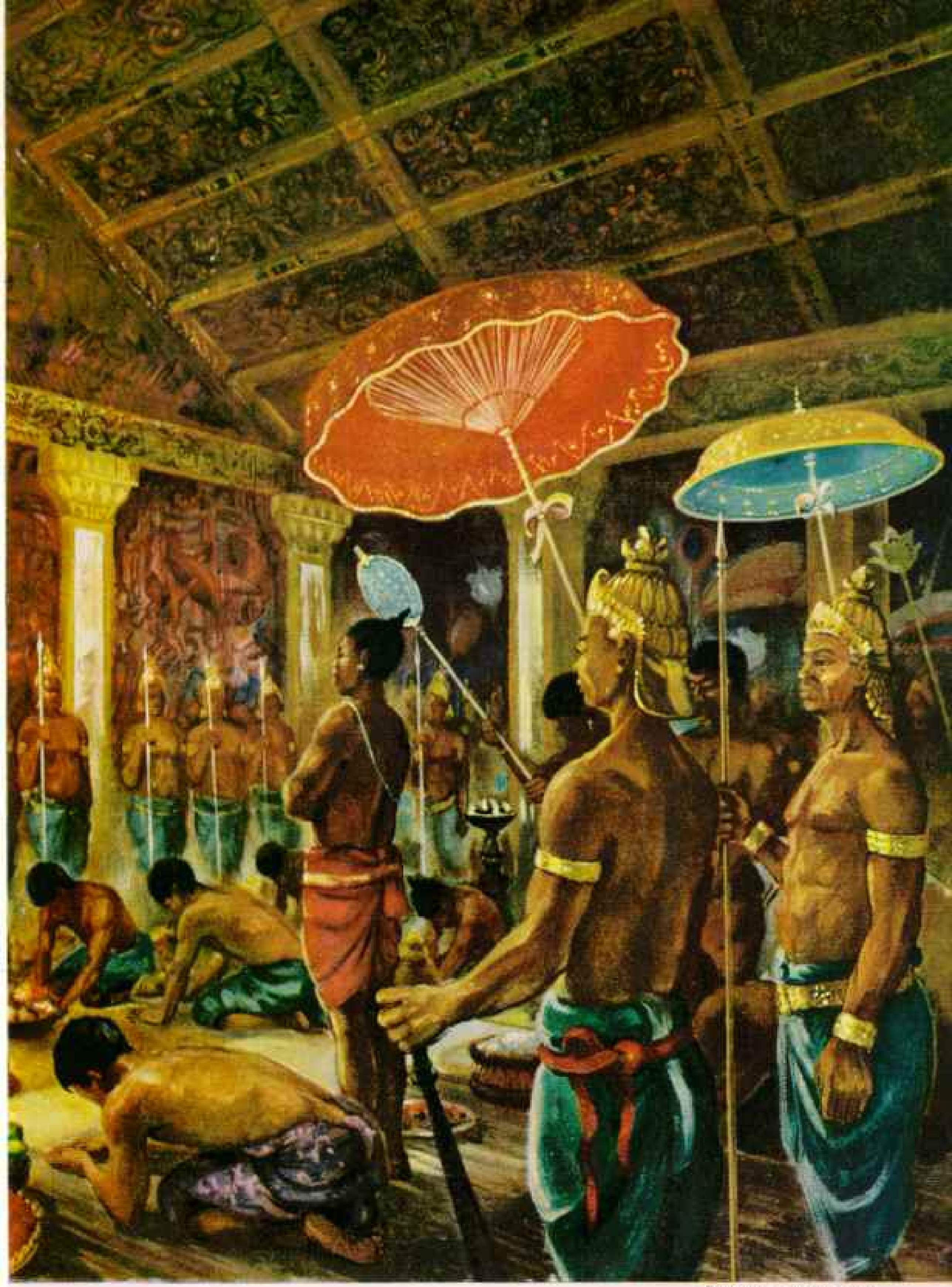
(*Continued on page 540*)

Heavenly dancers, supple *apsarases* trip across lotus blossoms. Carved in pairs and threes, thousands of these figures decorate pillars in the Bayon, the central temple of Angkor Thom.



Sword in Hand, the King Holds Audience From His Golden Window

As religious and secular chief, the Khmer monarch judged his subjects' disputes at hearings twice a day in Angkor Thom. A Brahman priest,



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identified by topknot and the white cord about his shoulder, presents a petition while standing beneath a parasol, possibly a gift from the king. Other suppliants, who offer baskets of fruit, prostrate themselves. "The council chamber," Chou Ta-kuan wrote, "has golden window frames."

Ministers and common people . . . strike the earth with foreheads

Chou Ta-kuan, the Chinese traveler, gives us an account of the salaams for a king

Brilliance marked the royal audiences. "Distant music is heard in the palace," Chou wrote. "Outside, they blow conch shells to welcome the king. I have heard that he uses only a golden palanquin. . . . A moment later one sees two palace girls lifting the curtain with their slim fingers, and the king, holding the sword in hand, appears at the golden window."

Chou implied that the king's sword was the symbol of sovereignty. Temple reliefs show other kings holding such a blade. Both Cambodian and Thai courts today possess a royal Sword of Victory. Legend says the Cambodian blade belonged to Jayavarman II, but its appearance gives small hint of such antiquity. Sheathed in a jeweled scabbard, it is preserved in the Royal Treasury at Phnom Penh and guarded by a corps of Brahmans who claim descent from the Khmers' royal chaplains.

Access to the monarch remains the people's right in the royal Cambodian court at Phnom Penh, but King Suramarit holds public audiences only once a week. Petitioners present community quarrels and other grievances.

Uplifted Parasols and Waving Fans on an Angkor Wall Pay Homage to Suryavarman II

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Caressed by countless hands, sandstone reliefs gleam like polished marble. Holy ones (top panel) ride to paradise; sinners (lower) suffer tortures of the damned.

The King of Champa assailed Kambuja with a strong fleet

Ma Tuan-lin, a Chinese historian, related the dramatic fall of Angkor in 1177, climax of a 30-year war.

"In 1171," Ma Tuan-lin wrote, "a [Chinese] mandarin was shipwrecked on the coast of Champa. [He observed that] both sides used elephants in fighting, without great advantage. The mandarin advised the king of Champa to use horsemen armed with crossbows, to whom he taught the art of using their bows on horseback. . . . The success of the innovation was enormous; victory declared itself for Champa."

A naval attack followed (next page). The shipwrecked mandarin guided the Champa fleet up the Mekong, into Tonle Sap, to Angkor's front door. Victorious, the Chams pillaged the city and put its king to death.

Jayavarman VII, an exiled Khmer prince, stepped into the chaos and created order. Raising an army and fleet, he sent the Chams reeling back to their own country, which before long he reduced to vassalage.

A contemporary of England's Richard the Lionheart, Jayavarman VII became Kambuja's master builder, constructing temples, palaces, and roads all over the kingdom. Where wooden palisades had protected Angkor before, Jayavarman reared sturdy stone walls that still stand.

War Canoes Charge Into Battle: Chams Defeat Khmers on the Tonle Sap

Which the Khmers and which the Chams? Artist Fiévet does not state, as sculptured bas-reliefs on the Bayon show little difference in their dress (page 541). Prows of both fleets bear images of

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the Garuda, a mythical half-man, half-bird sacred to the god Vishnu. As shouting warriors shake shields and brandish spears, one crew casts grappling lines about the enemy's bow. Survivors from a sunken boat grasp floating debris. Tusk-like projections from the hulls' painted fish-mouth figureheads appear to serve as battering rams. Screens along the gunwales protect oarsmen.

and demons, spear-hurling warriors and clawing monkeys. They are dramatic scenes drawn from Indian holy texts and the ancient classic epics, the *Ramayana* and *Mahabharata*, which the king may have chosen as symbols of his own life and deification.

In the eastern gallery, giants and demons tug at the multiple-headed *naga*—the hooded cobra—to churn a legendary Sea of Milk.

In another panel, the Day of Judgment, saintly figures rise to occupy exalted pavilions. The evil descend into the 32 hells to such tortures as having their bones broken, being thrust into boiling pots, pinioned on racks, or cast to wild beasts (page 537).

To me, however, a historical panel in the south gallery was the most important, for in it appear two splendid portraits of Suryavarman. One shows him seated on his throne, shaded by umbrella and fan, in audience with his ministers (page 536). Farther along the relief, he rides with his war lords and troops in ceremonial parade.

His *rajahotar*, or royal chaplain, accompanies the procession, along with attendants bearing the ark of sacred flame. An orchestra blows horns and conchs, beats drums and gongs. Buffoons cavort.

Many of these reliefs shine with almost glasslike smoothness. I soon discovered the reason: nearly every pilgrim who passed me ran his hand caressingly over the carvings.

From Angkor Wat I headed for Angkor Thom. Its southern gateway lies a little more than a mile north of the temple causeway.

Before reaching it, I came upon a roadside marker: Phnom Bakheng. Two stone lions sit a short way back in the tree shadows, and a gap in the branches exposes a steep path mounting toward the top of the forest-shrouded *phnom*, or mountain.

Here is Angkor's only hill. Historically it is an outstanding landmark, for it became the "holy central mountain" of the new capital, Yasodharapura, which Yasovarman I established here just before A.D. 900.

Fortunately for historians, Khmer monarchs loved to boast of their good works in dedicatory carvings on their stone temples. But the royal engravers reached fantastic heights of flattery in describing Yasovarman: "The best of kings . . . unique bundle of splendors," and "In all the sciences and in all the sports . . . in dancing, singing, and all the rest, he was as clever as if he had been the first inventor of them."

And prize boast of all: "In seeing him, the

(*Continued on page 542*)

BOLTON BELL ANDERSON (OPPOSITE AND BELOW) AND W. ROBERT MOORE, NATIONAL GEOGRAPHIC STAFF © N.G.S.

Battles rage on the walls of the Bayon. Khmer armies in top panel attack Chams in a forest; war canoes below ride bow to stern in mass assault—documentaries of combat nearly 800 years ago. Men knocked into the water swim among giant fishes.

Severed heads roll. Charging Khmers clutch foes by throats, ankles, and arms. Elephants trample warriors felled by mounted bowmen. Kambuja repulses a Cham invasion.

Crocodile jaws clamp the leg of a warrior fallen overboard in naval battle. Saurians in city moats discouraged invaders.

creator was astonished and seemed to say to himself, 'Why did I create a rival for myself in this king?' "

I don't know how, or how often, Yasovarman climbed this mountain to the sacred Siva shrine he erected on its crest. Years ago I rode up on an elephant. On this visit I set out afoot, lugging cameras and other gear.

Clouds of yellow butterflies rose before my steps. Monkeys scampered in the boughs overhead, taunting me. Before I reached the shrine, I wished for some of the athletic prowess Angkor's founder had boasted.

Five flights of steps, as precipitous as any in Angkor, mount the shrine's five terraces. On the topmost platform stand the five towers composing the main shrine. I sought the shade of its central tower. Resting, I reviewed the highlights of Khmer history that preceded the founding of this grand new capital.

Near the close of the 8th century occurred a dramatic incident whose outcome proved of extraordinary consequence to the kingdom of Kambuja. It centered upon an impetuous young king, whose name we do not know.

An Arab traveler is the authority for the account. According to his report, the young king and his councilor one day were discussing the powerful Sailendra, or "King of the Mountain," dynasty which then ruled a rich Indianized empire embracing Java, Sumatra, and Malaya.

Jealous of the Sailendra power, which may have partially controlled the maritime portion of Chenla, the young Khmer king said: "I have one desire I would like to satisfy."

"What is that desire, O King?" his councilor asked.

"I want to see before me on a plate the head of the King of Zabag" (Arab name for Java).

Word of the king's wish reached the Sailendra ruler. The Sailendra monarch amassed a thousand ships, appeared with his forces before the Khmer capital, and routed its troops.

Capturing the young king, he said, "You have manifested the desire to see before you my head on a plate. If you had also wished to seize my country and my kingdom or only ravage part of it, I would have done the same thing to Khmer. As you have expressed only the first of these desires, I am going to apply to you the treatment you wished to apply to me, and I will then return to my country without taking anything belonging to the Khmers. . . . My victory will serve as a lesson to your successors."

Lopping off the young king's head, the Sailendra ruler then said to the Khmer chief minister: "Look now for someone who will make a good king after this fool, and put him in the place of the latter."

Khmers Dug Vast Canal System

The chief minister's choice of a new sovereign proved abundantly wise. It was Jayavarman II—a monarch who declared Kambuja independent of all outside powers.

At the outset of his reign, Jayavarman II obviously felt insecure. He changed his capital no less than five times. Two of these centers were in the vicinity of Angkor; another was a fortress city he built atop Mount Kulen, 25 miles to the northeast. This mountain provided the vast quantities of sandstone used in Angkor's many temples.

In his later years Jayavarman II returned

(*Continued on page 548*)

RISE AND FALL OF THE KHMERS

A.D. 1-800:—Earliest Khmer kingdoms rise, dominated first by people of coastal Funan, then by inland Chenla. Warring factions eventually form two separate states.

802-850:—First powerful Khmer king, Jayavarman II, creates unified country of Kambuja (Cambodia) with capital near Angkor. (The word Angkor means "city.")

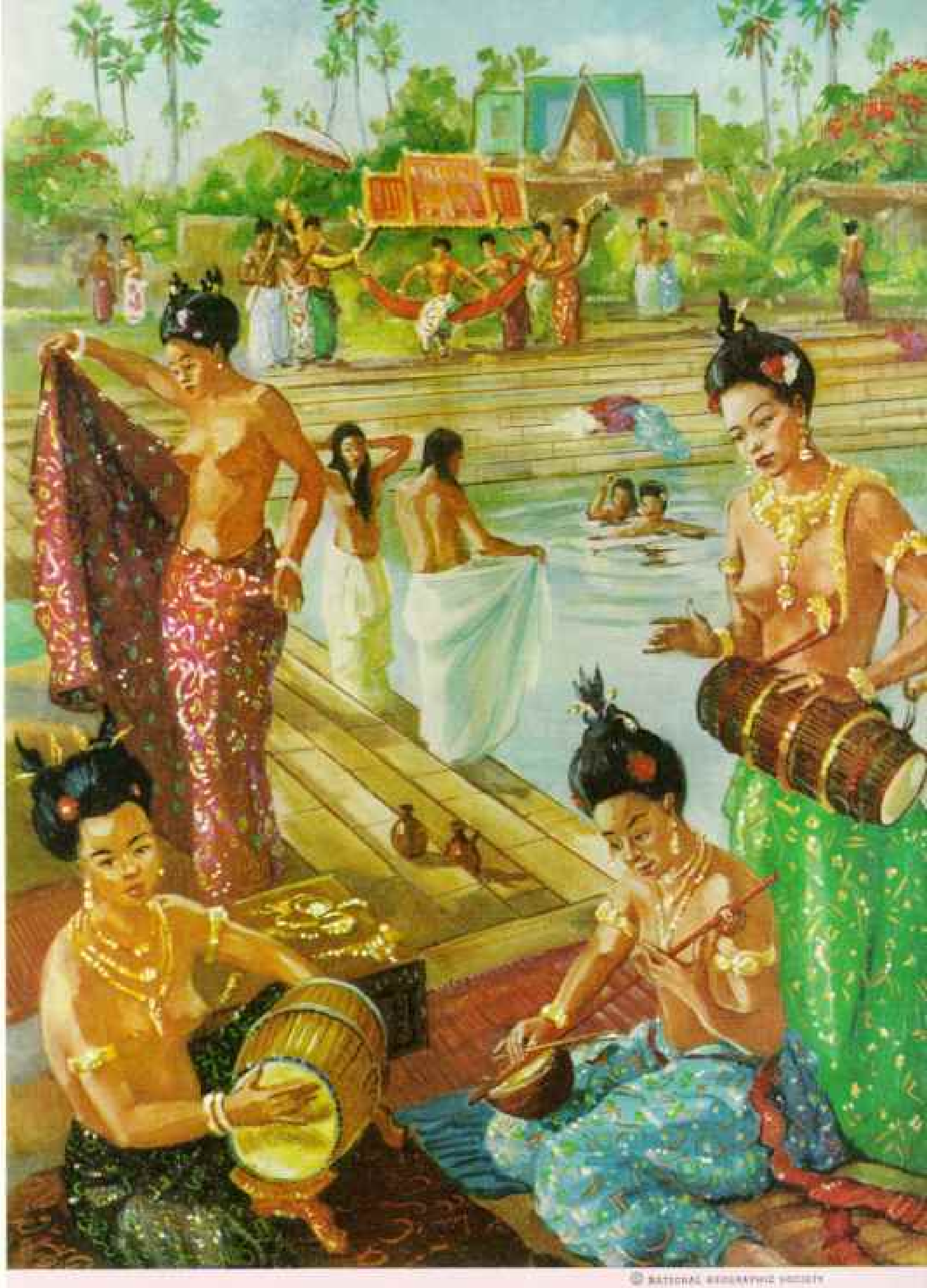
889-1100:—King Yasovarman I builds in 889 new capital called Yasodharapura, on site of present Angkor ruins. During next two centuries Khmer kings continue to expand city, add new temples.

1113-1150:—Suryavarman II builds in the capital the great edifice of Angkor Wat—literally, "city temple."

1177-1180:—Chams (from Champa, in present-day Viet Nam) defeat Khmers in naval battle, sack the capital. King Jayavarman VII rallies Khmers, drives out Chams.

1181-1220:—Jayavarman VII, greatest Khmer builder, expands empire and reconstructs capital, erecting walled city we know as Angkor Thom—"great city."

1431-1432:—Thai troops besiege and conquer Angkor Thom; Khmers abandon it.



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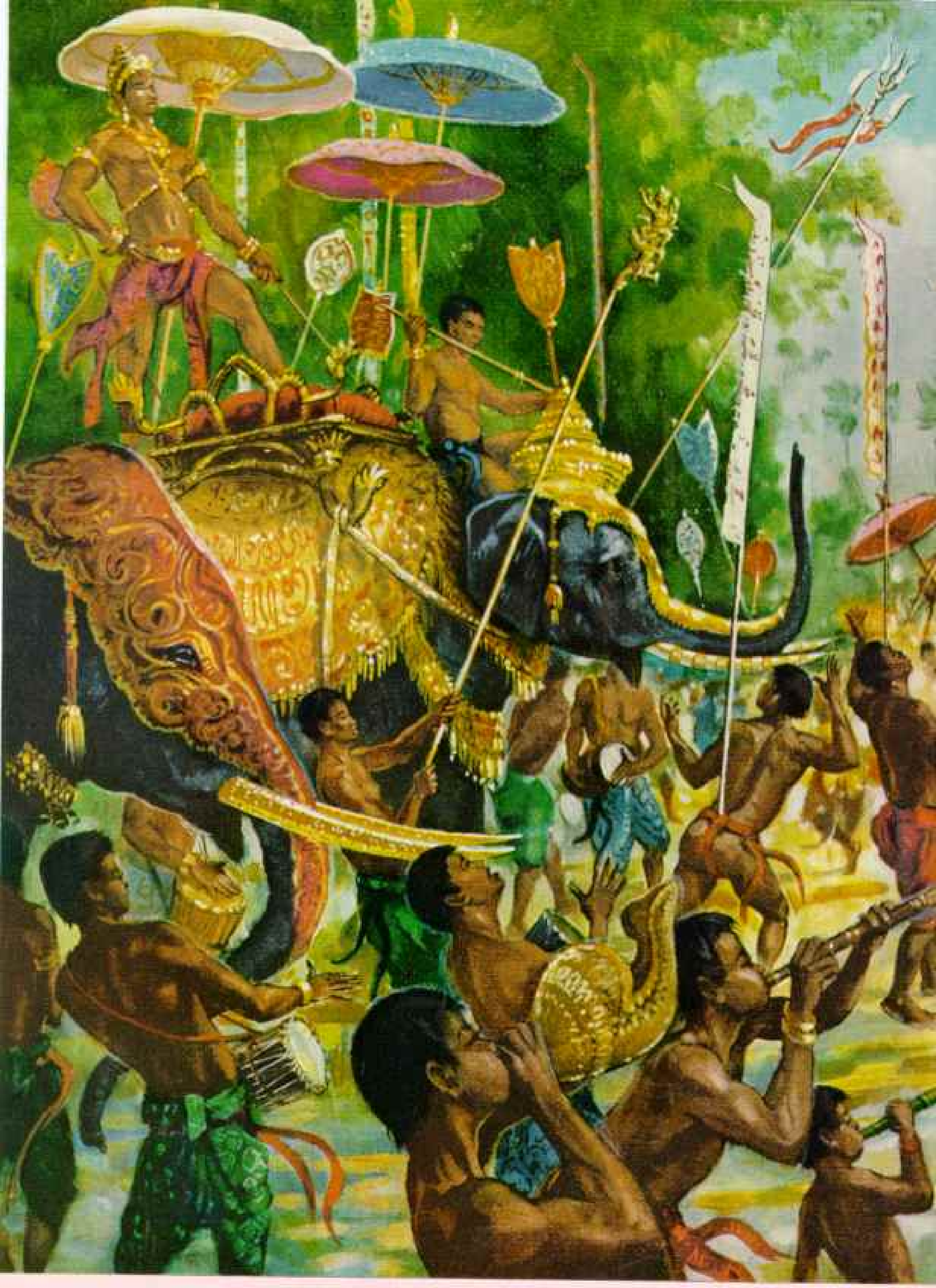
Among women of the noble houses one finds many as light as jade

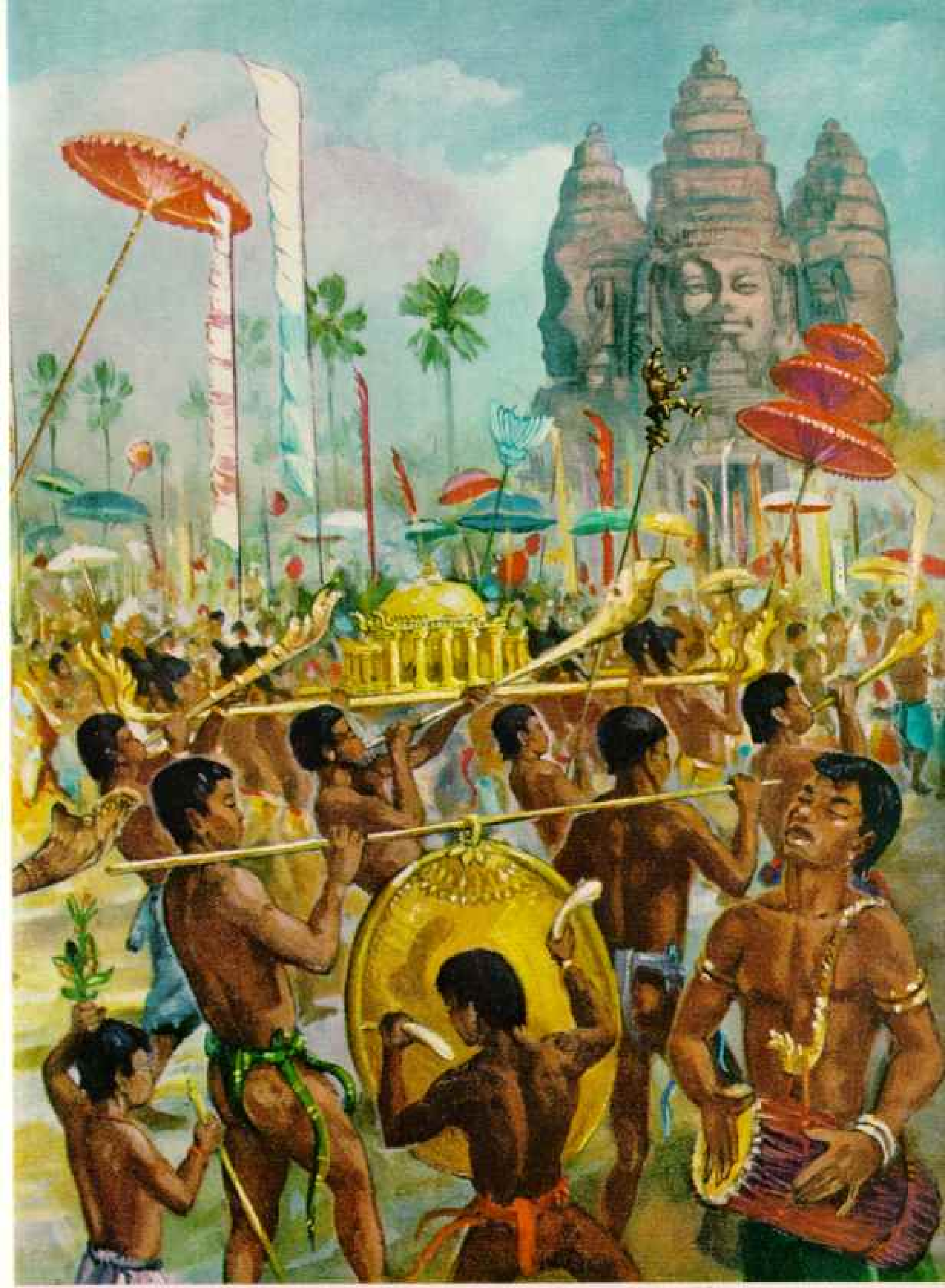
Chou Ta-kuan, who wrote our painting's title seven centuries ago, reports that "the king has five wives: one for the private apartment, properly speaking, and four for the four cardinal points. As for concubines and palace girls, I have heard it said that they number 3,000 to 5,000." Marco Polo, visiting neighboring Champa in the 1280's, wrote: "In that kingdom no woman is allowed to marry until the king shall have seen her; if the woman pleases him—then he takes her to wife; if she does not, he gives her a dowry to get her a husband."

Strings and drums entertain these ladies at their bath.



Conchs, Horns, and Gongs Herald a King Riding Through Angkor Atop His Elephant

Marching toward one of the city's four-faced gates, courtiers bear on their shoulders the ark of sacred flame. One attendant carries the royal



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insigne, a statuette of Vishnu and the Garuda. Banners, pennants, and mushroomlike parasols dance in the air. The royal elephant wears a golden crown; scarlet brocade veils its companion; gold plate veneers their tusks. Cambodian and Thai courts use similar regalia today.

The King, standing on an elephant, [its] tusks wrapped in gold

Witnessing a ceremonial procession, Chou Ta-kuan reported:

"When the king comes out, the cavalry leads his escort. Then follow the standards, the banners, and the music. Palace girls numbering three to five hundred . . . with flowers in their hair and tall torches in their hands form a troop; even in daylight their torches are lighted.

"Then come palace girls bearing the royal utensils of silver and gold and all the ornaments in varying styles. . . . Next come palace girls bearing the lance and shield. These are the private guard of the king, and they also form a troop. Then follow the goat carriages and the horse carriages, all ornamented in gold.

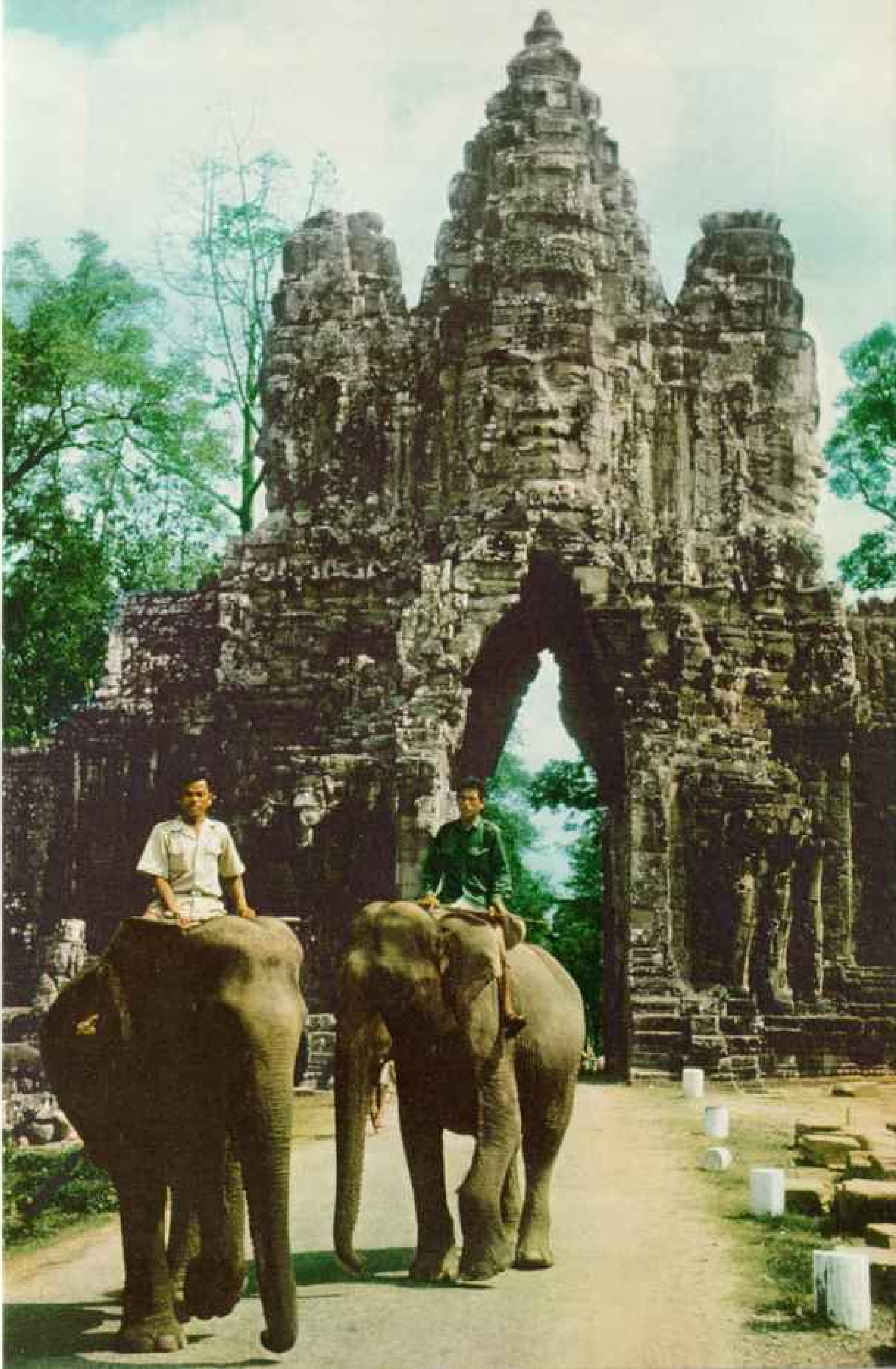
"The ministers and princes are mounted on elephants and, as they go forward, look afar; their red parasols are innumerable. After them come the wives and concubines of the king in palanquins, in carriages, or on elephants. They have, I am sure, more than a hundred parasols decorated with gold. Behind them is the king. . . ."

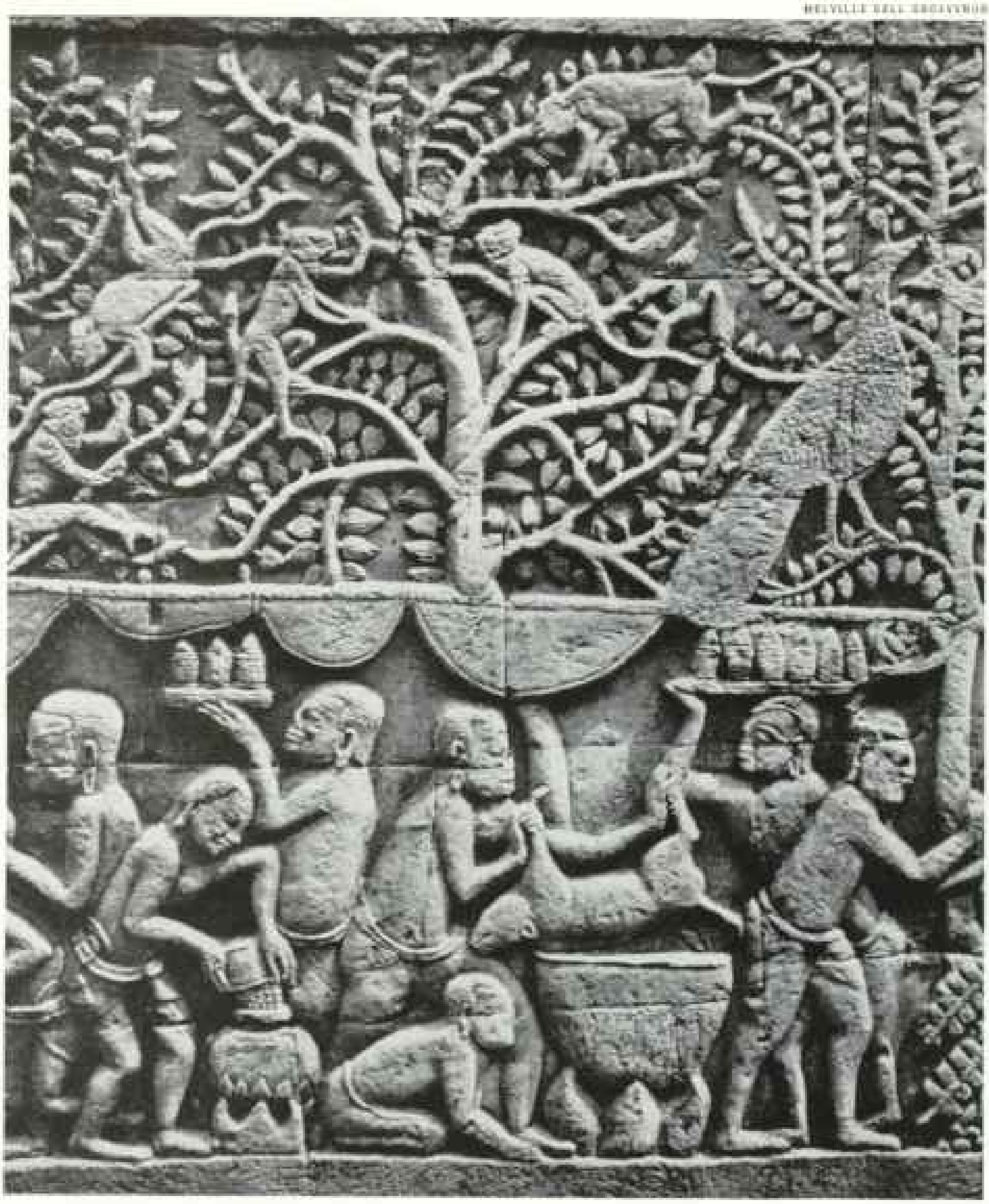
To compose the brilliant scene on pages 544-5, artist Fiévet draws upon Chou's eyewitness account and on other royal processions portrayed on the walls of Angkor Wat and the Bayon.

Elephants Parade Beneath Sculptured Faces of Angkor Thom's South Gate

Hunting elephants lift in their trunks a wild ox brought down by spear-wielding riders. Life-size figures of the ponderous beasts parade for hundreds of yards along Angkor Thom's Elephant Terrace, which faces the Royal Plaza.

KODACHROMES BY MELVILLE BELL GROSVENOR AND W. ROBERT MOORE (OPPOSITE) © N.G.S.





to Hariharalaya (Roluos), where earlier he had ruled for a short time. Jayavarman's two successors likewise used Hariharalaya as capital. And here Yasovarman I, the "best of kings," resided and expanded its building until he set up his new capital.

The Yasodharapura which Yasovarman created was by no means the city it was to become later, but he started it on its way to the grandeur we know as Angkor Thom. He marked out an area embracing more than six square miles. He straightened the Siem Reap River to form its eastern moat, dug canals to hem its other sides, and studded the city with hundreds of pools.

He also dug the huge Eastern Baray, an irrigation reservoir 4½ miles long and more than a mile wide.

Yasovarman's preoccupation with water was shared by all Khmer monarchs. God-kings though they proclaimed themselves, they were first of all masters of the land and its rice economy. Each new king added to the work of his predecessors to link rivers, reservoirs, and even temple moats into a vast water complex.

Later kings elaborated upon Yasovarman's grand plans for Yasodharapura, twice shifting the city a short distance northward. Finally Phnom Bakheng lay outside the walls altogether.

Looking from the hill now, I glimpsed only the lofty spires of Angkor Wat to the south-

Khmer Cooks Thrust a Wild Pig in the Pot

Numerous revealing scenes of everyday life crowd the walls of the Bayon. Women tend market stalls; men gamble, match fighting cocks, and fish with casting nets.

Peacocks and monkeys in treetops look down on this party camping in the jungle.

Double Walls Present an Archeological Riddle

After having built the inner wall and decorated it with carved figures, Angkor Thom architects added an outer wall for reasons no one has been able to fathom.

The so-called Leper Terrace above these walls may have served for royal cremations. Legends of a leprous Khmer king persist in Cambodia. By popular fancy, he is depicted by a Hindu image that sits on the terrace.

KODACHROME BY
STANLEY BELL CONVERSE © N.G.S.

ward, and, to the west, the shimmer of sunlight on the water of the Western Baray, another of the Khmers' huge irrigation reservoirs. All else was green jungle except for a few rice patches and the edge of the village of Siem Reap.

I descended Phnom Bakheng and continued on to the southern gateway of the city. Here I stopped, for a hundred faces were gazing at me —faces of giants and leering

(*Continued on page 552*)

The King ascends the belvedere
to be present at the festival

—Chou Ta-kuan

This brilliant circus emerges almost unchanged from wall carvings on the Bayon. The strong man supporting three dwarfs, the juggler spinning a wheel with his feet, and the tight-

rope walker all suggest the performers in a variety show today. Swordsmen fence, and acrobatic monkeys swing from a pole. A string-and-drum orchestra entertains the king, who sits on the far dais. Pleasure-loving Khmers also matched fighting wild boars, gamecocks, and elephants on the plaza facing the Royal Palace.

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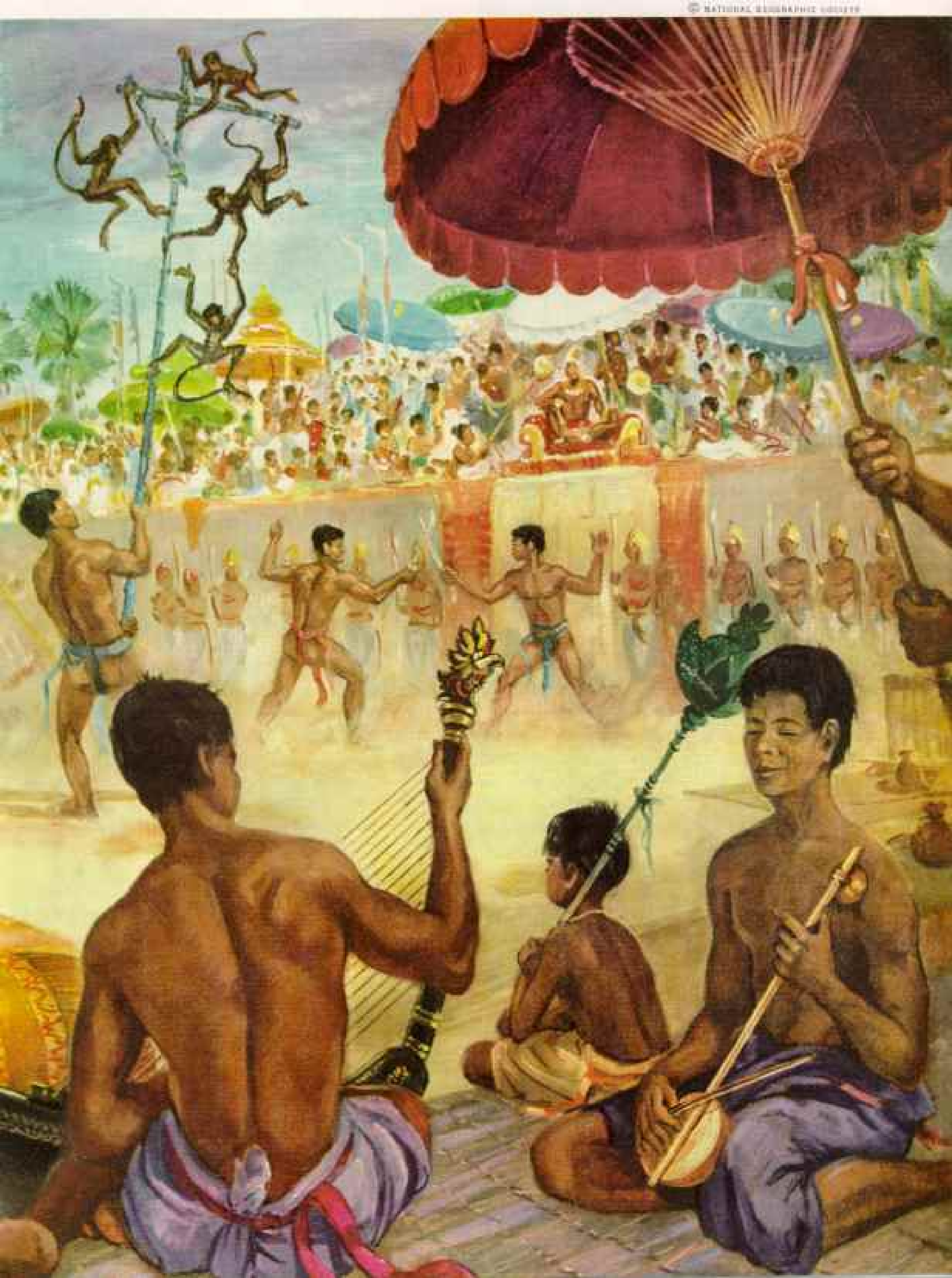


Arms lost, Jayavarman VII sits in a museum at Phnom Penh. His statue, its head broken off, was recovered from Angkor's ruins.

demons balustrading the moat causeway, faces on the triple-towered gateway itself.

At the time of my visit workmen were restoring the causeway; giants and demons stood ajumble, like a child's picture puzzle: find the faces.

But at the other gateways the figures stand in place on either side of the causeways. Giants faced me on the left, demons on the right. Though the figures kneel, they still were higher than my head. They hold clutched in their arms the bulky body of the multiple-headed naga.

Five massive gateways, all alike, penetrate the city's walls of laterite, a porous, claylike rock. The gateways are ornately sculptured, but it is the faces on their towers that draw attention—four faces on each, looking to the four points of the compass. Enigmatic faces they are, whose slightly smiling mouths evoke immediate comparison to the Mona Lisa. To visitors they have become the "Angkor smile."

Faces adorn the many towers of the Bayon,

(*Continued on page 556*)

His glory went from himself to the four points of space

Queen Indradevi, writing in flawless Sanskrit, eulogized her lord, Jayavarman VII.

Khmer artists carved many statues in the round, but virtually all their creations represented deities, temple guardians, or animals. The meditative figure taking shape under this sculptor's chisel portrays Jayavarman VII, Angkor's mightiest king.

Archeologists have found two of his statues, one at Phimai, in eastern Thailand, and the Angkor treasure shown at left. The head of a third image was unearthed recently at a town east of Angkor where Jayavarman appears to have dwelt before becoming king.

The four faces on the numerous towers and gateways built by the king repeat the statue's facial characteristics. They represent Lokesvara, a holy one who stayed on earth to do good works, but almost surely are stylized portraits of Jayavarman himself, an ardent Buddhist.

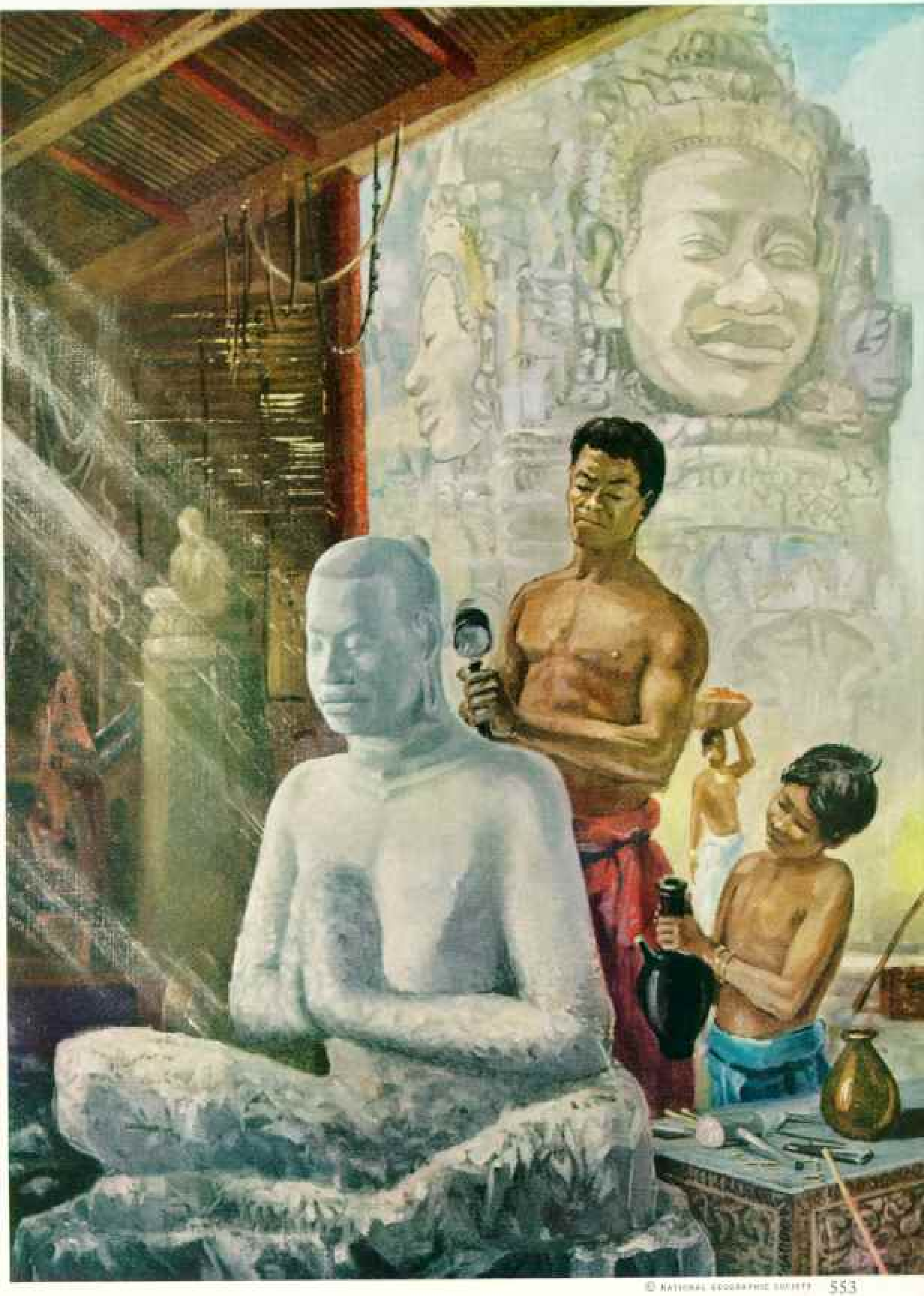
When Jayavarman came to the throne in the year of the "moon, sky, and Vedas"—A.D. 1181—his queen, Indradevi, wrote: "He rose up to save the land heavy with crimes."

Angkor's greatest builder, Jayavarman reconstructed the capital. He planned new palaces, pavilions, and the splendid Elephant Terrace that stretches for hundreds of yards along the Royal Plaza; he raised a mighty central temple, the Bayon (page 562), second in size only to Angkor Wat.

Nor was the king then content. He built large monastery centers—Preah Khan, Ta Prohm, and Banteai Kdei—adjacent to the capital. He erected other shrines and magnified outlying cities. An inscription records that he constructed more than 100 hospitals and erected resthouses at frequent intervals along the all-season roads he established throughout the kingdom.

Physically powerful, Jayavarman lived well into his 90's, using his years to expand the Khmer Empire to its broadest extent. Jayavarman thus could well say to his people:

"The good works that I have accomplished you should protect, for they are yours also."



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Rockets Flare in the Sky: King, Court, and People Celebrate the New Year

Flanked by nobles and attendants, the monarch sits on a dais and watches his ballet corps weave a magic pattern of color and movement. As the

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massive Bayon looms against the purple night, banners and pennons flutter beneath exploding fireworks. Chinese, long users of gunpowder, may have taught the Khmers how to mix nitrate, powdered charcoal, and sulphur to propel their bamboo-tube rockets.

Firecrackers as big as swivel guns shake the entire city

Spending the New Year at Angkor, Chou Ta-kuan described its brilliant two-week festival.

"In front of the palace," Chou wrote, "they erect a great platform capable of holding more than a thousand persons. This they cover with lanterns and flowers. Facing it . . . they collect wooden posts and fasten them together to form high scaffoldings. . . . Each night they build three or four or five or six. At the summits they place rockets and firecrackers. Expenses are borne by the provinces and noble houses. . . .

"Mandarins and nobles take part in the festival with candles and areca nuts; their expenditures are great. The king also invites foreign ambassadors to the celebration. This goes on for a fortnight."

Chou's report and temple inscriptions alike emphasize the dance's importance to court and temple celebrations. One festival, he wrote, was called *ngai-lan*, a word meaning "to dance."

One tablet describes a ritual procession in a temple and adds, "The musical instruments render a clamorous noise that charms the spirit. Then all around is the dancing of men and women."

Temple dancers served as the earthly counterparts of the graceful heavenly apsarases and devatas, entertainers of the gods, whose figures the Khmer artists portrayed on temple walls (opposite and page 533).

Today a glittering ballet corps, personally supervised by the Cambodian queen, provides entertainment for the royal court at Phnom Penh. Young actresses enact scenes from the same Indian classics and folk tales that the Khmers portrayed, but costumes have changed. Those worn today resemble Thai robes and crowns, emphasizing an odd exchange between Cambodia and Thailand that came about as a result of the Thai conquest of Angkor five centuries ago. When invading Thai pillaged Angkor, they carried away priests, artists, dancers, and artisans to enhance their court in imitation of the Khmers. Cambodia, in turn, drew from Thailand certain customs and court dances that originally had been her own.

the great central temple of the city; faces also gaze from gateways of shrines just eastward of the city wall. And I saw other faces brooding in the purple shadows of the jungle, although entwining tentacles of banyans cover their eyes and clutch at their lips (page 566). These faces represent the compassionate bodhisattva, known to the Khmers as Lokesvara. But they, and the structures they grace, also stand as the symbol of one man, the last great builder-king of Angkor—Jayavarman VII (page 553).

Indeed, much that remains of Angkor Thom, as well as many outlying shrines, can be credited to this one prodigious builder.

Dramatic Upheaval Shakes the Empire

Jayavarman VII was contemporary with Richard the Lionheart of England. He came to his throne—fought his way to it—after one of the most dramatic upheavals ever to shake the Khmer Empire—the sack of Yasodharapura by the Chams, whose kingdom, Champa, occupied part of present Viet Nam.

For years the two countries had been engaged in almost continual land battles. Then suddenly, in 1177, the Chams assembled a powerful fleet, sailed boldly up the Mekong into Tonle Sap and captured and pillaged the capital.

To Jayavarman VII, who earlier had refused to assert his right to the throne against a usurper, fell the task of ousting the Chams. He proved equal to it. He drove out the Chams, brought order out of civil chaos in the kingdom of Kambuja, and began the monumental task of rebuilding.

He completely reconstructed the capital and erected the thick protective laterite walls to replace earlier wooden palisades. He expanded the Khmer Empire to its farthest reaches, reduced Champa to little more than a tributary province, and built more extensively, perhaps, than any other man on earth.

Indeed, some authorities on the Khmer civilization believe that he so exhausted the country by his building that he actually contributed to its decline.

Compassionate King Bears Subjects' Ills

Unlike most of his predecessors, Jayavarman was Buddhist. And he seemed to have a passion for his people that none of his predecessors had displayed. The 102 hospitals he built afford excellent example. On their foundation inscriptions appear these words: "He suffered from the ills of his subjects more than from his own; for it is the grief of the

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Eight centuries stand between royal dancers and their predecessors carved on Angkor Wat. Pageant endures, but dress has changed: half-clad apsarases are no more.

people that causes the grief of kings, and not their own grief."

It is doubtful that any structure ever erected is more complex or baffling in architectural design than the Bayon (page 562). Built upon the foundations of some earlier structure, it was expanded, elaborated upon, and altered so extensively that it became a warren of galleries, sanctuaries, and chapels. It grew into a complex pantheon, housing the images of Khmer dignitaries and relatives whom the king deified.

The Bayon may not be the best Khmer art; certainly its architecture is flawed by hasty construction. But the shrine is a remarkable outpouring of spirit. Where Angkor Wat is formal, its carvings precise, its figures drawn from legend, the Bayon is intimate, warmly human.

Its reliefs portray battles, but they are down-to-earth battles between the Khmers and the Chams. Here, too, are naval engagements, actual battles against the Chams. Great serpent-headed war barges manned by rows of oarsmen collide; warriors are hurled overboard into the maws of hungry crocodiles.

Carvings Duplicate Life Today

The Bayon's walls show kings and priests in ceremony, royalty watching sports. But they also portray intimate personal scenes of everyday folk, everyday pursuits.

Women gossip in the market place amid

(*Continued on page 562*)

Of the qualities acquired, the highest is knowledge

A Khmer stone tablet quotes the Code of Manu, the ancient Hindu law book, to emphasize the importance of learning.

Scholars here prepare scripts on sections of palm leaf. Etching the characters with a stylus, they ink the entire strip, wipe the surface clean, and leave the black deposit only in the lettering. Brahman at lower right stacks finished texts for binding with string.

Khmers also wrote on hides, but fire and jungle rot destroyed such fragile books long ago. Only temple inscriptions endure, some written in Khmer, others in Sanskrit, the sacred language of the Brahmans. "Having drunk the nectar of knowledge," says one inscription, the king ". . . gave it to others to drink."

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JOHN BEDICHEVIAN

Ink rubbed across paper brings out a Khmer inscription on a stone. Children get similar impressions with pencil rubbed across paper and coin.

The author, at Preah Khan, examines an inscription stone that records the temple's dedication to a king "who honored without ceasing the feet of Buddha." Like a similar stone at Ta Prohm, the stele details the temple's images, personnel, and supplies.

The earth is plunged into a sea of ruin wrought by the enemy

After 1431 no one left a record of the Thai final conquest of Angkor. Our woeful title is taken from an account of an earlier but less disastrous defeat.

Climaxing nearly a century of war, Thai troops overwhelmed Angkor after a seven-month siege. A fifth column of traitors and the death of the Khmer king abetted the enemy's cause. Victorious Thai looted the city of everything they could carry away.

When the Thai enthroned their own king's son as Kambuja's overlord, the rightful heir assassinated him and took over. Viewing Angkor as indefensible against further attack, the king moved his court to the south and abandoned the city. Five centuries of glory ended; jungle crept in.

Angkor's heavy burden in maintaining its ornate shrines contributed to its decline and fall. The growing power of surrounding kingdoms robbed the once-dominant Khmers of the tribute, taxes, and slave labor upon which they had built their strength. Moreover, Hinayana Buddhism had become the popular religion, undermining the powerful god-king cult.

For the next several centuries the kingdom remained independent and carried out wars against its Thai and Annamese neighbors. Then, gradually weakening, it became little more than a buffer between the Annamese and Thai.

In the 1860's the French began domination of the region, calling it Indochina, but lost it in 1941 to invading Japanese. After World War II France briefly reasserted its mastery but finally gave in to nationalist and Communist pressures.

Cambodia, whose name is a Western adaptation of Kambuja, regained its independence in 1949. Its people number some five million.

 Death of Angkor: Victorious Thai loot the city and march away prisoners;

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in 1432, a year after the disaster, the Khmers abandoned their capital

their stalls of fruit and fish. Men gamble and match fighting cocks. Jugglers, acrobats, and midgets perform to the accompaniment of a string-and-drum orchestra. Fishermen cast their nets into waters teeming with scaly fish, turtles, and crocodiles.

Men, camping in a forest, drop a pig into a cooking pot. Their companions boil rice and roast spitted fish. Above, from the tree branches, frolicking monkeys, squirrels, and birds gaze down upon them. A water buffalo suckles her calf and at the same time scratches her head with her hind hoof.

For hours I explored the Bayon's reliefs, enjoying the homely scenes and marveling at how many are duplicated in Cambodia today.

ANDRE REVIL GROUVERNOR © NATIONAL GEOGRAPHIC SOCIETY

Among the descendants of the Khmers, women still dominate the markets; men gamble, fish with the same circular nets. Oxcarts, like those halted in stone, lumber along the bush trails, their wheels screeching on dry axles.

While photographing a battle scene to record the weapons the Khmers used—spears, bows, knives, and heavy ballistas mounted on

Ghostly Faces Peer From Towers and Nooks on the Bayon

First a Buddhist shrine, Jayavarman VII's monument became a temple to Siva. During centuries of neglect tree roots split roofs and walls, but many carvings survived. How many faces can you count?

elephants and two-wheeled carts—I happened to glance beyond the terrace to a man cutting weeds. He was using a *phkeak*, a sharp blade bound to a bent-end shaft shaped like a golf club. Its design was identical with that of weapons carried by kings parading in stone.

Only one other document compares with these bas-reliefs for a contemporary look at life in Yasodharapura. A Chinese visitor, Chou Ta-kuan, spent eleven months in the capital in 1296-97 and wrote an extensive account of what he saw.

He thus scored a prize journalistic scoop that Asia-roaming Marco Polo only a few years before had completely missed. Polo saw northern Burma, touched coastal Champa, but failed to see Kambuja. And as a result, the Western World never knew of Angkor's existence until its jungle-buried bones came to light.

At the time of Chou Ta-kuan's visit the country had been ravaged by war, but he found Yasodharapura of remarkable splendor.

Some of his descriptions serve as a revealing guide to its remains today. He mentions the giant-and-naga-balustraded causeways and the gateways, but inexplicably states that the latter had five faces instead of four.

He describes the many-towered Bayon, saying that it shone with gold. "On the eastern side," he wrote, "is a golden bridge, on each side of which are two golden lions, while eight golden Buddhas are placed at the base of the stone chambers."

He refers to another impressive temple as the "copper tower." This was the Baphuon, which stands northwest of the Bayon.

King Meets Snake in Tower of Gold

Archeologists have identified the Baphuon, a multiple-stage pyramidal temple, as the *svarnadri*—"mountain of gold"—erected about 1060 by King Udayadityavarman II. It still is imposing, though it has long since lost its crowning pinnacle, which presumably was built of wood and gilded, or sheathed in copper as Chou Ta-kuan suggests. Upon it Khmer artists carved some of their first decorative bas-reliefs.

An older, smaller pyramidal temple, farther north in the very center of the palace quarter, intrigued Chou Ta-kuan even more. The "tower of gold," he called it. Now it is known as the Phimeanakas—the "aerial palace."

He echoed the belief of the common folk of the city, stating that it was a palace which the king visited every evening. "In the tower dwells the spirit of a nine-headed serpent, who is master of the soil of the whole kingdom," he wrote. "It appears every night in the form of a woman. . . . If one night the spirit of this serpent does not appear, then the king's time has come to die. If the king fails to come for a single night, some misfortune will happen to him."

It is an intriguing tale, but in plain fact the Phimeanakas was a temple, not a palace.

Monarch Appears at a Golden Window

Chou Ta-kuan tells about the palaces, the gilded and mirrored audience halls and pavilions, which at the time surmounted the magnificent Elephant Terrace. But he states, "I have heard say that inside the palace are many marvelous places, but there are very severe restrictions, and it is impossible to enter."

He wrote vividly about the king's appearance twice a day at a golden window in one of the pavilions to conduct the affairs of government and judge the complaints his subjects brought before him (page 534).

From Chou Ta-kuan's descriptions one can visualize the brilliant ceremonies that animated Yasodharapura: the New Year's celebrations with their fireworks displays that went on for a fortnight (page 554); the ceremony of washing the Buddhas; the sacrifice of the first fruits by "burning the rice"; and the royal processions to the temples.

An indefatigable reporter, Chou Ta-kuan recounts that all except the poorest families owned slaves, who dwelt beneath the stilted houses.

He describes the rice poultices used by the women in childbirth, the judgment of quarrels by ordeal, and the disposal of the dead by wrapping the bodies in matting and cloth and carrying them outside the city for vultures and dogs to devour.

Some Khmer customs shocked him. One of

Half-man, Half-monkey Guardians Leer From Steps of Banteai Srei

A 10th-century cameo of Khmer art, this small shrine stands 20 miles from Angkor. When discovered in the forest, its towers and walls lay in a tumbled heap; French archeologists reassembled them. Pink sandstone walls and pediments still blossom with flowers, cobras, and other figures. Banteai Srei means "citadel of the women."

KODACHROME BY JEAN CHOW © NATIONAL GEOGRAPHIC SOCIETY

them: the frequency with which the people took baths and washed their heads!

To him the Khmers were boorish and very dark, but he admits that "among the people of the palace and the women of the noble houses there were many as light as jade."

Artist Fiévet takes us into a few of the palaces from which Chou Ta-kuan was barred. He shows us some of the light-as-jade palace ladies: a princess being arrayed with her ornate jewelry and some of the "3,000 to 5,000 concubines and palace girls" bathing (pages 532 and 543).

Today several palace pools have been excavated. When I sought them out, a group of Cambodian folk sat eating their lunch in the shade of a spreading banyan beside a pool rim. Brown youngsters clad only in sunshine and water droplets raced up and down the stone steps where the palace beauties once descended to their baths.

Jungle Roots Spread on Palace Mold

Twelve stone towers, often called the Towers of the Cord Dancers, stand opposite the Royal Plaza. Chou Ta-kuan asserts that they were used as places of ordeal for litigants, but their purpose still is debated.

Other shrines of various sizes, ages, and stages of preservation strew the city. But forest cloaks much of Angkor Thom today. Water channels and bathing pools have vanished; jungle roots thrust deep into the mold of crumbled palaces and homes.

Outside the city walls rear many other temples, each with its own architectural, historical, or personal appeal.

Leaving by the north gate, I went to Preah Khan, a labyrinthine monastery temple of linked galleries and sanctuaries which Jayavarman VII built upon his field of victory over the Chams. He dedicated Preah Khan to his father, and may even have used it as his capital while rebuilding Yasodharapura.

Jungle has damaged the shrine badly. Though partially cleared, its walls are broken and askew.

Driving out the eastern Gate of Victory on another trip, I came to an ancient Khmer bridge. Parts of 14 arches remain, bypassed now by the Siem Reap River which cuts around one end. Near by is Ta Prohm, monastic city similar to Preah Khan, built by Jayavarman VII and dedicated to his mother.

Wandering through Ta Prohm, I found it one of the most intriguing ruins of Angkor. For here, aside from clearing access paths, the conservators—French scholars who have restored Angkor—have left the structures as they first found them, overrun by the jungle.

Huge, buttressed silk-cotton trees, banyans, and other forest monarchs interlace their prying roots among the temple stones and weave their branches into a thick canopy overhead. Here tiny threadlike tendrils grope for flaws or cracks in the masonry. Other tentacles are swollen into great grasping, prying arms. Massive roots coil and twist to uptilt heavy flagstones, split whole walls and corbeled arches, and bring down ornate façades.

Moss overgrows fallen stones, spreading a green fuzzy veil over softly rounded figures and smiling faces. A spider casts a web over a woman's bare bosom. Doorway guardians stand leprous with lichen.

Yes, Ta Prohm is like a prisoner manacled and trussed by heavy ropes. Doomed for half a millennium, it refuses to surrender. It gives way only a little in one place, a little in another, as generation after generation of its assailants rise up to tighten their bonds.

After having visited Ta Prohm, it was a sudden relief to see blue sky and look at other temples cut free from the bush. It was as if bonds against which I had been struggling had suddenly been severed.

Bookkeepers Carved a Record in Stone

There is an inscription in Ta Prohm which records precisely what the temple once was. Ta Prohm, says this fantastic record, enshrined the image of Jayavarman's mother (portrayed as Prajnaparamita, the "perfection of wisdom") and 260 other statues. Eighteen high priests and 2,740 ordinary priests officiated in its ceremonies, aided by 2,232 assistants, of whom 615 were women dancers. Once 12,640 persons resided within its walls, and another 66,625 men and women supplied food and other services—nearly 80,000 persons in all attached to this single monastery!

Listed also were the quantities of rice, beans,

Pythonlike Banyans Grip a Giant Stone Face in a Living Vise

During the jungle's five-century reign in Angkor, banyans, silk-cotton trees, and vines caught temples and towers in a crushing grip, and probing roots demolished entire walls. This head in a wooden cage guards a gateway to the temple of Ta Som.

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millet, butter, curds and whey, molasses, camphor, mustard, wax, pepper, oils, and other supplies used for offerings at the temple.

Its treasury, we are told, contained gold vessels weighing more than 11,000 pounds and nearly the same amount of silver, 35 diamonds, 40,620 pearls, 4,540 other precious stones, 967 Chinese veils, 523 parasols. . . .

Imagine, then, the splendor of other temples which were even larger!

Buffalo Loll in Royal Bath

Almost abutting the southeast corner of Ta Prohm is Banteai Kdei, a smaller version of Ta Prohm, also built by Jayavarman VII. More delightful than the temple is the water expanse of Sras Srang (royal bath) which stretches eastward from a naga- and lion-ornamented terrace.

This reservoir is never dry, and I found its mirrored waters being put to good use by bathing groups of laughing Cambodians. In a far corner lazed a herd of water buffalo, submerged to their uptilted noses.

About a mile beyond Sras Srang lies Pre Rup, a triple-terraced, five-towered shrine, built in the mid-10th century by Rajendravarman II.

Cambodians today say that Pre Rup served as a funerary shrine. A group of lads following me pointed out a rectangular walled pit at the base of the eastern stairway where bodies supposedly were cremated. Their number included, legend relates, a king whose fondness for sweet cucumbers caused his downfall.

This king, the tale goes, acquired such a passion for the cucumbers grown by a certain gardener that he had a special patch planted for his personal appetite. He gave the gardener a spear and cautioned him to keep alert watch lest some of his precious cucumbers be pilfered.

Overwhelmed one night by his craving for cucumbers, the king went down to the garden. Whereupon the watchful gardener, failing to recognize his master, stabbed him to death. As fitting climax, the gardener later was chosen king, since the slain monarch had no direct heir.

It is a jolting 20-mile jeep ride over a rutted road northeast of Angkor that takes you to the 10th-century temple of Banteai Srei, an exquisite cameo of classic Khmer art—and a superb example of reconstruction by the conservators of Angkor. When found in the jungle, it lay in a tumbled heap. Now its gateways, its libraries, and its three towers, set on a low platform, again stand strong.

Banteai Srei means "citadel of the women." And indeed it has a smallness and grace that are orientally feminine. Built of rich pink sandstone, Banteai Srei seems to glow with the blush of a maiden's cheek. Its surface is deeply carved; the swirling patterns of leaves, flowers, and figures seem almost to stand apart from the basic stone.

Lovely full-breasted, smiling dancers and serene male guards occupy numerous wall niches. Gods, monkeys, and elephants battle on the library façades.

In some ways Banteai Srei is almost too ornately decorated, too feminine, its faces too sweet. And it seems as if its architect, Rajendravarman II, sought to correct it by placing about its steps odd, kneeling, human-bodied figures with heads of weird lions, hook-beaked birds, and apes with gaping mouths (page 564).

Banteai Srei seems almost intended as a model, a toy temple, whose rich design might one day be used in some magnified master shrine. Its towers rise no more than 30 feet; the doorways are only about four feet high; and some of its steps rise no more than three or four inches.

When the great temple, Angkor Wat, was built more than a century and a half later, some of Banteai Srei's classical Khmer grace and chiseled perfection went into it. But Angkor Wat became big, solid, masculine. And its gray sandstone gives it a measure of cold, stern aloofness happily absent from tiny Banteai Srei's blushing, lace-embroidered stones.

Brooding Faces Guard Dead Empire

One can spend a lifetime seeking out and studying Khmer shrines and still not see them all. Hundreds of structures, large and small, strew the forests of present-day Cambodia. More stud Thailand and Laos.

Some are ruins of early capitals, some holy mountain retreats. Some, such as Banteai Chmar, in northwest Cambodia, and Beng Mealea and Preah Khan of Kampong Svai, east of Angkor, are remnants of once-spectacular cities whose shrines rivaled those within the capital.

How many temples and palaces the Khmers built of wood—for they were first of all master carvers of wood—we cannot even guess. Only when the capital moved to the Angkor

MELVILLE BELL GROSVENOR

Like seconds in a prize ring, owners and backers prepare fighting cocks for combat; a detail from the Bayon. Soon spurs and feathers will fly; one group will lose a bet.

region did quantities of laterite and sandstone become readily available.

In reviewing the sweep of Khmer culture, one comes always to the brooding faces. Serenely they gaze upon the encircling forest. They did not mark the end of Angkor, but they rose near the beginning of its end.

They were created by a king who revived an empire from chaos. They looked upon a succession of monarchs who, for 200 years after Jayavarman VII, built nothing of importance.

These kings lived luxuriously, performed their god-king rites, but exercised less and less power. The Thai, the Annamese, and the Lao grew stronger, depriving the Khmer monarchs of land, taxes, tribute, and slave labor.

Those faces of Angkor also saw the gentle, humble Hinayana Buddhism come to cut beneath the lofty god-king cult, finding its appeal among the common folk.

Finally the smoke of pillage and stench of war assailed their broad stone nostrils. The kings decamped to humbler station, humbler capitals, and the jungle walked in.

Now, 500 years later, the faces still serenely smile. Men have come to piece together Angkor's history; visitors come to see and wonder.

At the Western Baray, I watched engineers of the Ministry of Agriculture, assisted by American aid, working with bulldozers, concrete mixers, and ditchdiggers. They were renewing the old reservoir embankments and re-establishing canals to water lands where once spread a panorama of irrigated rice fields.

So came the Khmers; so they flourished, and so they departed. In a summary in his book *The Ancient Khmer Empire*, Lawrence Palmer Briggs says: "The Khmers left the world no great systems of administration, education, or ethics, like those of China; no literatures, religions, or systems of philosophy, like those of India; but here Oriental architecture and decoration reached its culminating point."

Here, hemmed by jungle, stand the remains of the Khmer temples. And here gaze the serene, meditative faces reminding one of that heroic builder, god-king or giant, who erected the final majestic Angkor.

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A versatile new baby submarine aids man's exploration under the sea

Diving Saucer Takes to the Deep

By CAPT. JACQUES-YVES COUSTEAU

Leader, National Geographic Society–*Calypso* Expeditions

A STRANGE and startling sea monster is coming straight at me, and I am delighted.

I am 65 feet down in the sapphire-clear Caribbean waters off Guadeloupe, breathing through my Aqua-Lung and writing instructions for the monster on a white dinner plate with my black grease pencil: "Turn right."

The monster turns at once, nimbly as a seal. Then it stops, its Plexiglas-and-steel eyes pointed at me, awaiting further orders.

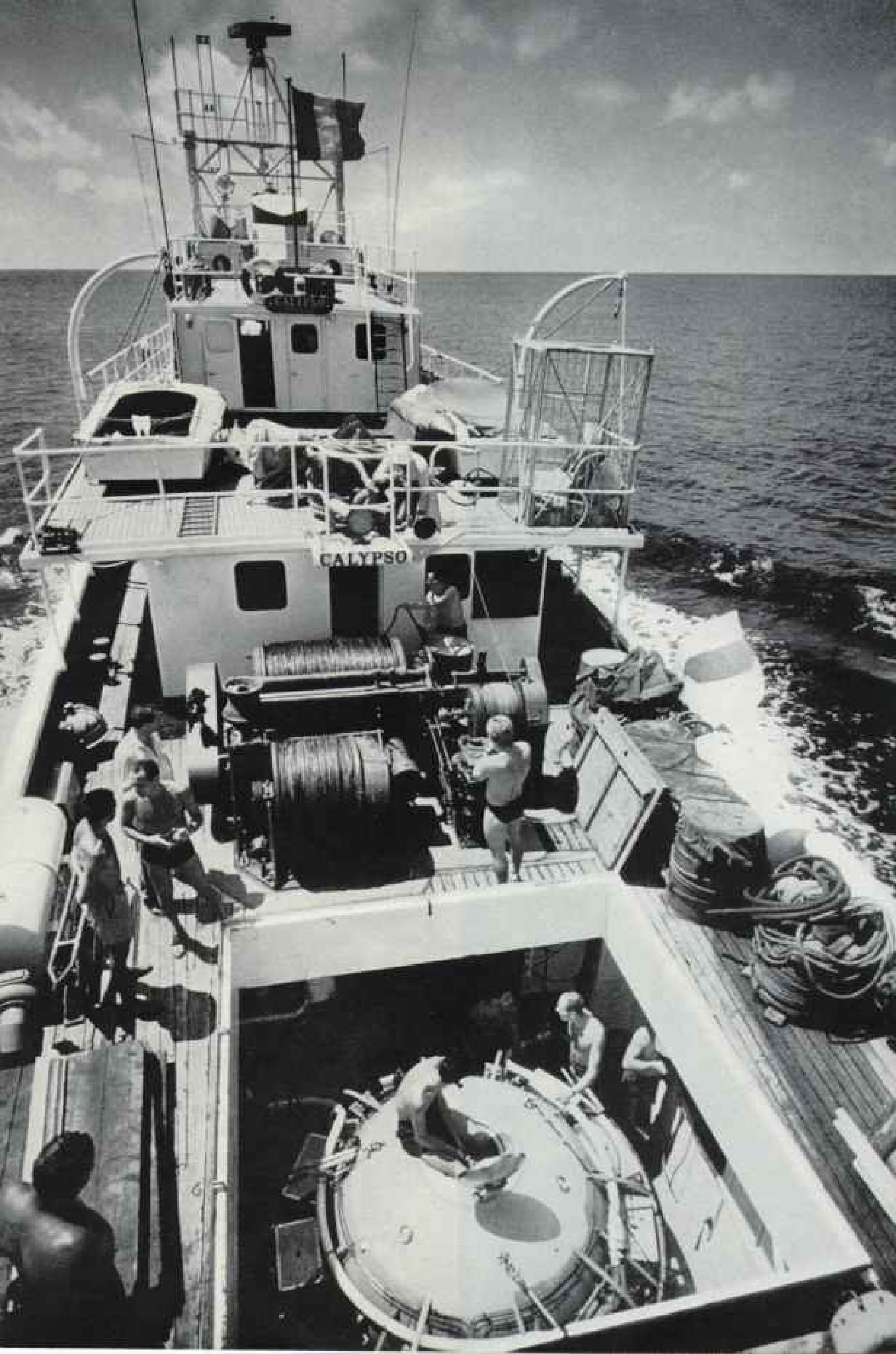
I address it in French, of course, because this obedient marine monster is French. It is, in fact, an unprecedented piece of diving apparatus with two Frenchmen inside—lying on their stomachs, one behind each eye.

They are putting this new "diving saucer," as we call it, through its first tests with our National Geographic-*Calypso* expedition. I am overjoyed, because already I can see that this odd jet-propelled vehicle will let us fulfill a dream: to descend deeper and stay longer than the free diver can, while still being able to move, look about, and even pick things up. This is revolutionary. The way opens for geological and biological research in a marine twilight zone no man could explore freely before.

The germ of the diving saucer idea came to us in 1951 during the first *Calypso* expedition, to the Red Sea. We swam down the vertical

Science fiction becomes fact as a jet-propelled diving saucer hovers over the Caribbean's sponge- and coral-studded floor off Guadeloupe. Pilot and observer, peering through twin portholes, scan the blue depths at 60 feet.

HIGH SPEED EKTACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS J. ABERCROMBIE © N.G.S.


CALYPSO

reefs to 210 feet—the working limit for an expert with the Aqua-Lung. Below, in the transparent water, we saw the rich wall of life extending beyond our reach; for even the most expert Aqua-Lung diver should descend no more than 300 feet, and to this depth only if he stays no longer than a minute.

To explore the virgin depths beyond, a pressure-resistant shell must surround the diver. But a regular submarine, or a deep-diving bathyscaphe, would be too big and clumsy for intimate reef exploration.* We needed a radically new submarine, something small, agile.

Continental Shelf Beckons Explorers

The time was ripe for such a craft. Free divers were patrolling everywhere in the sea's top layer. And the bathyscaphe was eventually to take man down some 37,800 feet—7.2 miles—to the bottom of the oceans' deepest known hole, the Mariana Trench off Guam.

But between these extremes lies the richest zone of sea life—teeming, beckoning, unexplored. That region is the continental shelf, the offshore slope of a continent out to the ledge where, at depths of roughly 600 feet, the bottom drops sharply into the deep.

"Our baby submarine should be small enough to carry on the *Calypso*," I said to André Laban, Director of our French Undersea Research Center at Marseille. "It should take two men to about a thousand feet and let them stay down six hours. It should be as maneuverable as a free-diver, if possible."

We were not bound by the forms of any previous submarines. Water trials of various models led us to a flattened sphere as best for our hull shape—two dished halves of three-quarter-inch steel.

We ordered three hulls. With safety much in our minds, we lowered the first one at sea with no one aboard. To make it sink while empty, we fastened heavy iron ballast to it with 30 feet of chain.

As the saucer dipped below the surface, the crane cable parted, and the steel bubble sank to the sea bottom, 3,300 feet down. On our depth sounder we picked up a distinct echo for the hull. We knew that it was intact, because there it floated 30 feet off the floor—tethered like a balloon to its anchoring ballast.

The *Calypso* has crossed the test site many times in the 18 months since. The hull is still floating down there. We thus became confident that our thousand-foot dives would have a safety factor of three plus.

The Undersea Center also took a fresh look at propulsion possibilities and rejected propellers in favor of hydrojets on both sides of the hull, powered by an electric pump. This system simply takes in water and forces it out through two nozzles. There had never been a jet submarine, but only such jets promised the great agility we wanted.

Many French and American engineering groups joined to shrink into saucer space the necessary electric motors, pumps, and instruments. The Committee for Research and Exploration of the National Geographic Society, then under Dr. Lyman J. Briggs, provided financial backing for this pioneering venture, and so did Air Liquide Cie. in France and the EDO Foundation in the United States. It took courage to invest money and material in such an unorthodox idea.

Last July the diving saucer was far enough along to be christened in Marseille by Mme. Denise Mollard. She is the patient and understanding wife of Jean Mollard, the young electrical engineer who became our dedicated *constructeur*, as French Navy people call a shipbuilder. The first jet submarine was fittingly named *Denise*.

A few days later, when *Calypso* sailed on a scientific cruise, *Denise* was loaded in her special garage in the afterhold (opposite). At the last moment, Mollard decided to come along and made a pierhead jump aboard. He worked on the little sub until we reached Puerto Rico, to start diving operations off Punta Aguila on the island's southwest tip.

Denise Makes Her Maiden Dive

The first day we lower *Denise* without the crew to weigh her for neutral diving buoyancy. We weigh pilot Albert Falco and engineer Mollard on the *Calypso* and add them to the calculation. The following day the saucer crew goes down for the first time, hung from the ship by a braided nylon cable that will, in effect, be weightless in water.

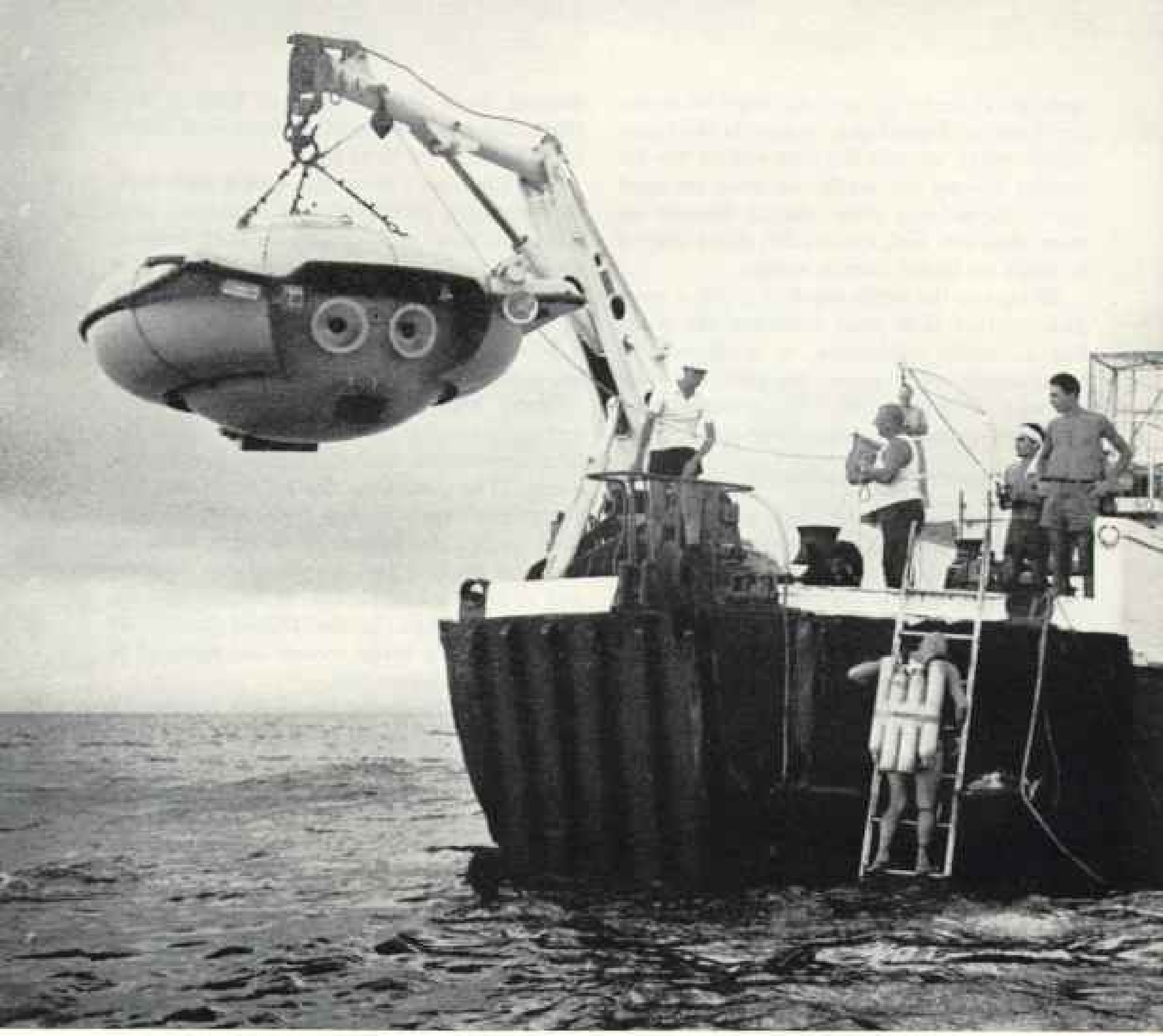
Before the dive we make a "preflight" check,

* For other articles about the bathyscaphe, Captain Cousteau, and the oceanographic research vessel *Calypso*, see NATIONAL GEOGRAPHIC for January, 1960; March, 1958; February, 1956; April and August, 1955; January and July, 1954—The Editor.

Saucer, on a Transatlantic Crossing, Rides Snugly in *Calypso*'s Hold

A remodeled U. S. Navy mine sweeper, *Calypso* provides a floating laboratory, workshop, and diving platform for Capt. Jacques-Yves Cousteau's fish men. As *Calypso* crossed the Atlantic, coiled cables on her main deck at times dragged camera- and flash-bearing sleds along the sea bottom, making a pictorial sampling.

THOMAS J. ABERCROMBIE



JACQUES COUSTEAU, CALYPSO OCEANOGRAPHIC EXPEDITIONS

running down a list of 26 saucer functions to see that all is in order. The check is completed. Falco and Mollard are sealed in. I am on the turntable of the powerful Yumbo hydraulic crane at the stern. This six-ton precision crane is a superb mechanism. With the hook, a skilled operator can flick the ash from a cigarette.

As *Denise* slowly disappears beneath the glassy waves, I feel deeply that this is an important moment for diving. I feel also a mixture of satisfaction and frustration. From the first, Falco was to be the pilot, but I intended to make the initial dives with him. Now I cannot go. My place is on deck, handling the crane and mother ship during the first critical launchings and recoveries.

I have planned a series of shallow dives to get Falco perfectly acquainted with the saucer. We call these dives "the auto school." My turn will come when the saucer is allowed to dive beyond the range of the Aqua-Lung.

Still, I am almost jealous of the men inside. And concerned. Will the cable hold? If it breaks, the saucer must sink. Will the ballast weights stick, leaving the men helpless on the bottom? The saucer has no rudder or tail planes; will the jets work for steering as well as for propulsion?

We have our answers when we see Falco emerging from the saucer's hatch. He smiles, and his face is brighter than the sun. He can turn each jet nozzle full circle. When he points them downward, *Denise* moves up; when he points them upward, *Denise* moves down. To turn left, he uses the jet power of the right nozzle only. To turn right, he uses the left nozzle.

To slow down, he reduces the flow from both nozzles; to stop suddenly, or to reverse, he points both nozzles forward. Falco is enthusiastic about the controls, even though the saucer has been tied to the ship by the cable.

For the next dive, *Denise* will no longer be suspended from the ship but from a free-floating buoy to allow Falco greater freedom of

movement. Once more the saucer is off the deck and over the stern. Sailor Albert Aliprendi climbs on the saucer to remove the shackle before *Denise* is immersed (below).

The nylon cable is snaking limply through the water. We transfer it to the buoy. If anything should go wrong in the dive, we can recover the buoy and raise the saucer.

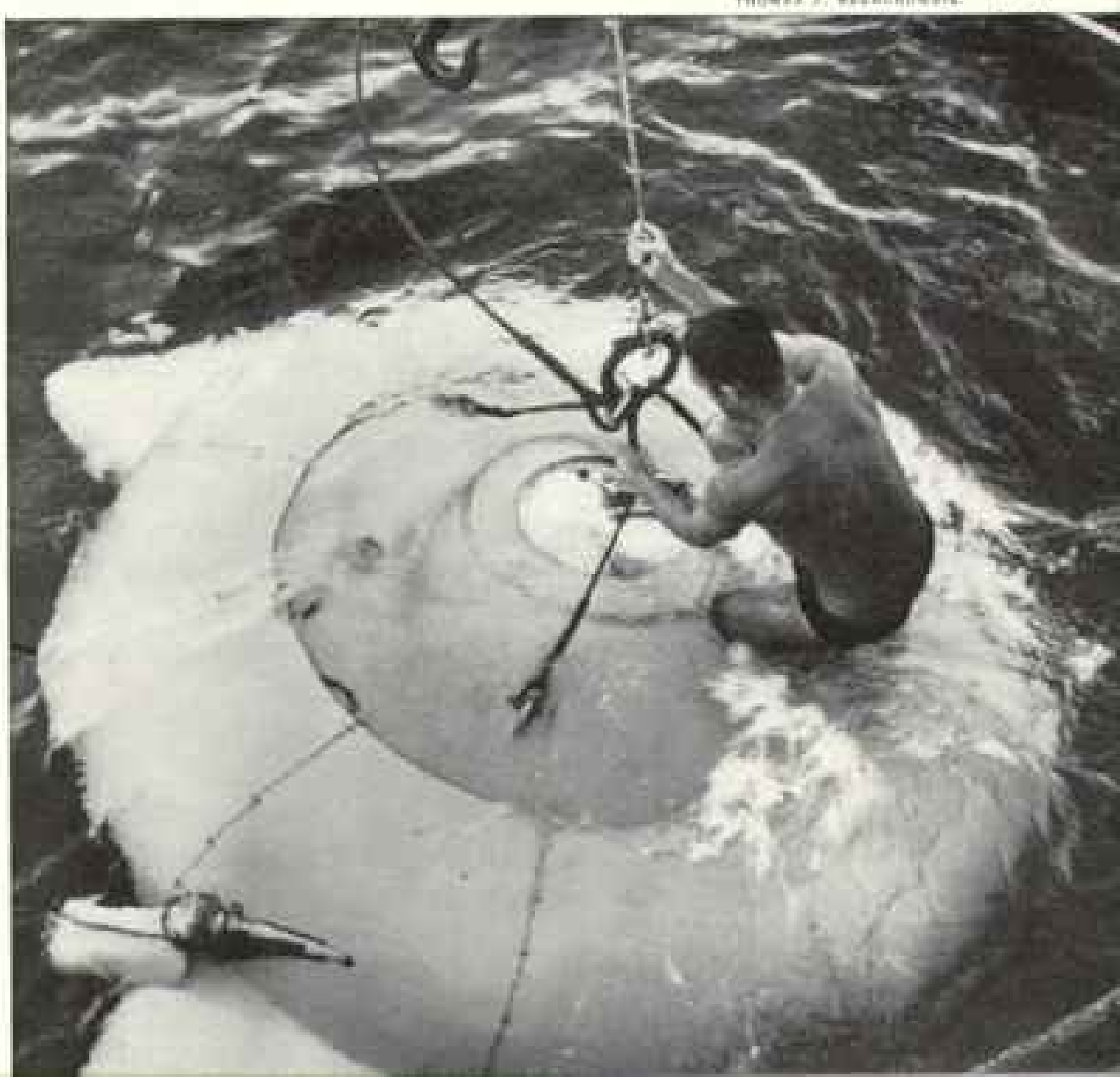
The buoy begins to move. Falco has given the diving saucer her head. We watch the buoy parading around on the surface, and everyone yells with delight, "*Ça marche!*"—it works!

As Falco and Mollard report later, the resistance of the cable and buoy is so slight that they feel they have won the freedom of the sea. They are under way 150 feet down, peering with enchantment at luxurious scenes near the bottom. Mollard spies a three-foot striped bass, lazily swimming ahead of them. Falco starts to chase the fish, which does not accelerate and lose the submarine as it could easily do; *Denise*'s top speed is but a knot and a half. They marvel that they can turn almost as whimsically as the fish.

Then Falco feels something tugging at the saucer. Her speed diminishes! The trailing nylon cable has fouled on a big coral clump they have just passed. Falco kicks over the jet nozzles, and the saucer backs around the coral head, unwinding herself.

What if this maneuver had not worked?

THOMAS J. REDCHOWICZ



All hands stand ready for action as the saucer drops seaward off Guadeloupe. Captain Cousteau (in white cap) operates the overhead crane. Aqua-Lunger on ladder will follow the saucer part way down. Sailor on rubber raft with outboard motor will detach the line.

Unhooking the cable from the crane. Albert Aliprendi frees the saucer for a plunge. Hydrojet nozzles (left foreground) propel and maneuver the revolutionary craft. Crewmen ride in a steel, pressure-resistant hull. Main motor, jet pump, and batteries are wrapped around the hull and sheathed with removable Fiberglas covers (diagram, page 579).

We would have spotted the stationary buoy on the surface and sent free divers to the saucer's aid, for in this dive Falco had not descended beyond free-diving range. Had he been caught lower down, however, he would have been in a serious predicament, calling for the ultimate emergency measure—escape from the saucer.

Denise is equipped for that too. She carries two Aqua-Lungs, two life jackets, and an inflatable rubber raft. And we have considered the problem of how to open the hatch despite the enormous weight of water pressing it down during a deep dive. If trapped beyond help, Falco must turn on a compressed-air tank inside the hull, raising the air pressure inside the saucer to equal the water pressure outside. It should work, but escape would be no picnic.

Jet Sub Plays the Whale

For the enthralled jet hydronauts, the short time allotted to this dive ends quickly. Falco levers a 50-pound iron block, and the saucer climbs.

When she surfaces, Falco stages an unexpected show. He points both jet nozzles upward and runs the water pump. Two geysers squirt 25 feet in the air. "There she blows!" yells the enthusiastic crew. Then we know that in the future, if *Denise* plays the whale, she will easily be spotted.

We lift the saucer aboard with the steel tackle. Falco's grinning face pops out of the hatch, and he yells, *"Ça c'est de la bagnole!"* This might be rendered as "What a hot rod!"

We sweep Falco and Mollard into the mess and celebrate with champagne. The first coherent remark from Falco is, "Commandant, the saucer wants to be free." He adds, "She needs no more lines to the surface. They are dangerous."

I agree that this is the end of cables, except for unmanned dives that will precede each deeper one with men aboard. We must be cautious.

"And we must find better diving grounds," I tell skipper François Saoût. "*Denise* needs really clear water for her big debutante party." We trace fingers down the chart to the Leeward Islands, as far as Guadeloupe. There the soundings show that the land drops sharply into the deep, leaving only narrow ledges which promise to be free of the murky surge we found in the shallow shelf off Puerto Rico. Arriving at Basse Terre, one of Guadeloupe's two main islands, we see that we have hit it just right.

When *Denise* dives, everyone is crazy to go down with an Aqua-Lung to see her. A dozen men swim after our little monster as she glides through sea fans, staghorn coral, and veils of little damselfish and butterfly fish.

But on a working oceanographic ship there is more to do than goggle at a jet submarine. I set the divers a tough job—to hack specimens of coral life from a vertical reef for study by the National Museum of Natural History in Paris.

The crewmen of *Denise*, lazing on their foam-rubber cushions, enjoy the sight of the peasants toiling in the sea. Next year *Denise* will be fitted with a hydraulic claw to do such jobs herself—deeper down, too.

Falco is having a delightful time learning what the diving saucer will do. For him it is like the finest electric train a boy could have. He bottoms the jet sub on a patch of fine sediment without stirring up a cloud. He pumps mercury ballast forward and the saucer rides bow-down, revealing the floor eighteen inches below.

Under his eyes a little silvery fish pops out of the bottom, swims up, and looks them over gravely. Then it vanishes back into the sand tail first. The fish repeats the trick. Falco surfaces with the impression that we shall see fish behavior from the saucer that the free diver might never see.

Noisy Monster Plumbs the Depths

As the dives grow longer, I abandon my anxious perch on the platform of the crane. I swim down to watch her before I board the *Calypso* again to handle the recovery.

Seeing *Denise* underwater, I am struck irrationally with the notion that she is a natural marine creature. It is hard to think otherwise when one sees her poised like some great bivalve or strange crustacean. It does not easily occur to us that there are two human faces behind the staring eyes.

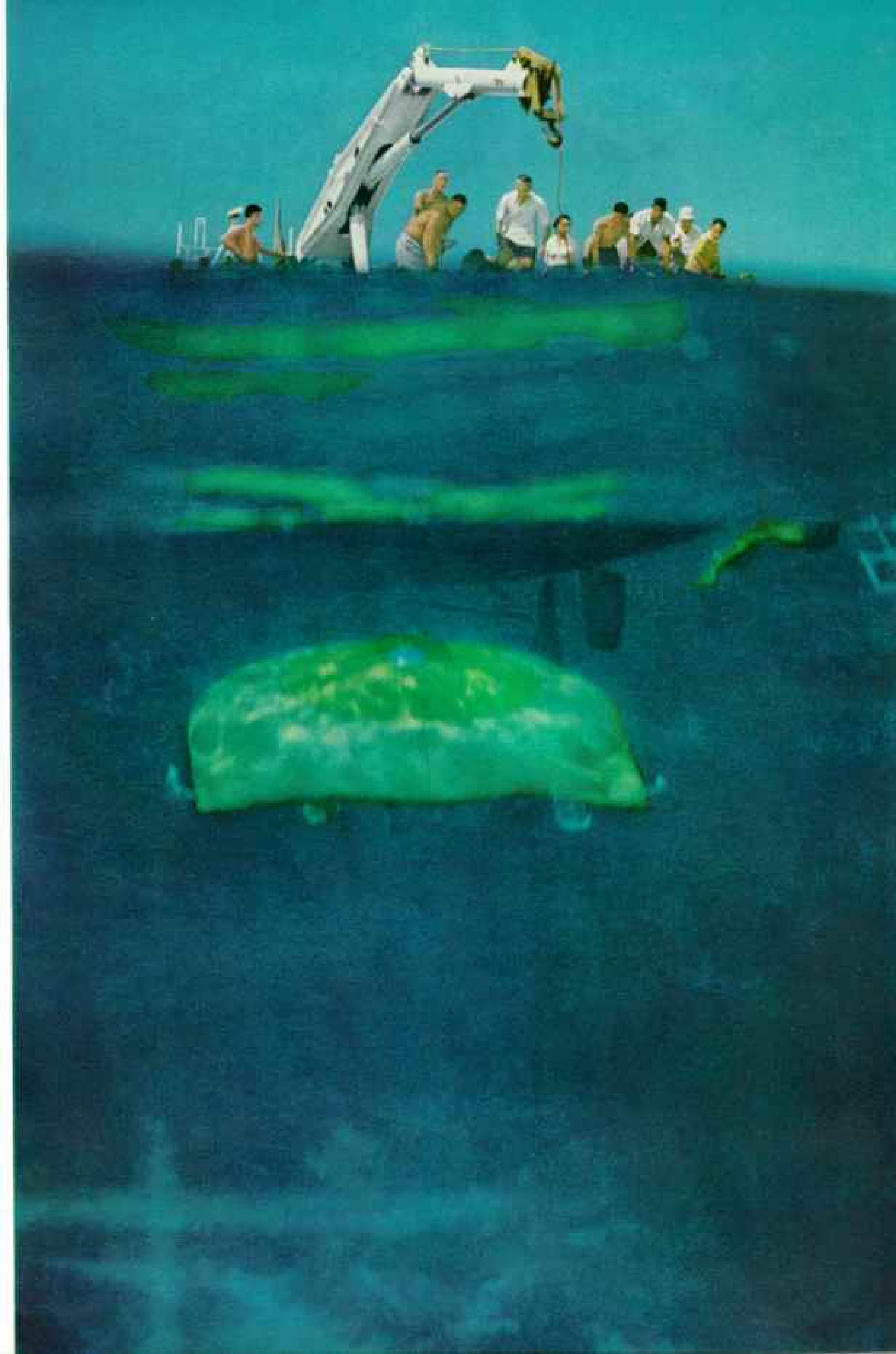
I feel a sudden rush of fright as *Denise* fades down the sloping reef. I am responsible

(Continued on page 580)

Down, Down Goes the Diving Saucer. Launchers Follow With Anxious Eyes

Swimming free at the surface, photographer Abercrombie held his specially made camera half above water and half below to get this striking shot. Both *Calypso*'s deck and submerged hull stand out; even the 75-foot sea floor is visible. Sunlight bouncing off the saucer casts a gleam on the surface.

EKTACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS J. ABERCROMBIE © N.G.S.



KODACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS J. ABERCROMBIE © N.G.S.

Lying Prone on Foam Rubber Mattresses, Crewmen Peer Through Plexiglas Ports

A 12-inch polished glass ball suspended in the cabin reflects the interior and enables the camera (center) to catch this panorama. Jean Mollard (left), the submarine's engineer, triggered the shutter. His companion, Albert Falco, is the pilot.

In this view the saucer rests on *Calypso's* deck. Tropic air calls for swim trunks instead of the coveralls usually worn in the cool depths.

A continuous instrument panel girdles the interior of the pressure hull: depth gauges, barometer, compass, ammeters; hydraulic pump; tape recorder (the sub's logbook); and an EDO sonar unit that gives readings of the distance from the surface, bottom, or any obstacle ahead. An air-cleansing system removes carbon dioxide and emits pure oxygen.

The saucer has *no rudder or tail planes*. For control, it depends entirely on movements of the jet nozzles and regulation of their flow. To turn, the pilot suppresses the jet flow on one side. To cruise up, down, or forward, he swivels the jet nozzles in a full circle.

Key to the artist's diagram below: (1) Pilot lies prone. (2) Engineer adjusts electrical controls. (3) Pressure-resistant shell of forged steel, ¾ inch thick, is designed to protect divers at depths to 1,000 feet. (4) Fiberglas outer casing, non-pressurized, streamlines the vehicle. Power assemblies lie between inner and outer shells; thus the crew faces a minimum of danger from fires or noxious gases caused by motors or damaged batteries. (5) Jets squirt sea water, propelling and guiding the submarine. (6) Hydraulic pistons rotate jets for maneuvering. (7) Electric pump powers propulsion jets. (8) Suppressors help steer the ship by shutting off the flow of sea water through one of two jet pipes. (9) Six main batteries hang outside the pressure hull.

PAINTING BY GILBERT A. ANDERSON © NATIONAL GEOGRAPHIC SOCIETY

for putting two men in that shell. I ought to be in there myself.

The submarine dissolves from sight, but I can hear her characteristic noises—the sibilant whine of the electronic-flash converter, the periodic growl of the oil pump, the drone of the propulsion motor. The sounds tell what Falco is doing. The depths fall silent. He has bottomed at 230 feet as planned. I swim back to the *Calypso* and pace the deck, waiting. All goes well; *Denise* returns.

Papa Flash Takes a Dive

On the morning of the sixth dive, I find Prof. Harold E. Edgerton, electronics expert from the Massachusetts Institute of Technology, tinkering with the flash camera he has built especially for *Denise*.

I say, "Papa Flash, would you like to make a dive with Falco?"

Edgerton replies, "Sure! You mean it?"

"Come with me," I say. In my quarters I weigh him on a bathroom scale. He is 20 pounds heavier than Mollard. We subtract this amount of weight from the ballast and begin the predive check.

Harold disappears into the saucer with a big smile. He is sealed in with Falco, who gave him his first Aqua-Lung lessons eight years ago. Although I have not yet descended in the saucer myself, I feel that Harold deserves the honor of the first dive by a scientist. Aided by National Geographic research grants, he has given mountains of labor to the deep-sea photography program of the *Calypso*.

HIGH SPEED EKTACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS J. ABERCROMBIE © N.G.S.

Floating on the Sunlit Surface, Snorkel Men Gaze Down at the Camera

Sea plumes brush the saucer as it perches on the bottom. Exterior equipment includes (left to right) the tubelike headlight, high-speed still camera, electronic flash for the still camera, and a retractile flood lamp (atop the hull). A motion-picture camera inside the hull focuses through an opening between the twin ports.

He was the first American to descend in a bathyscaphe, and now he is the first in a diving saucer.

Professor Edgerton wrote a log of his dive, from which I give extracts:

"Now we were slowly sinking, free of the cable. Above us, through the optical ports, we could see the *Calypso* resting at anchor in the exceptionally clear water. Falco turned on the water jets, and we began to move. Like an airplane we descended to where the reef dropped off into deeper water. . . .

"We were getting good, clean oxygen. Being in the saucer was no different from being in an automobile, except that we had more room and lolled comfortably on our foam mattresses like Romans at a banquet. . . .

"Falco spotted a squadron of squid, swimming against the bottom in perfect formation, but they were out of camera range. As he cut the jets, the submarine settled slowly into an undersea garden with a slight crunch of coral. A host of fishes of many colors circled us.

(Continued on page 585)

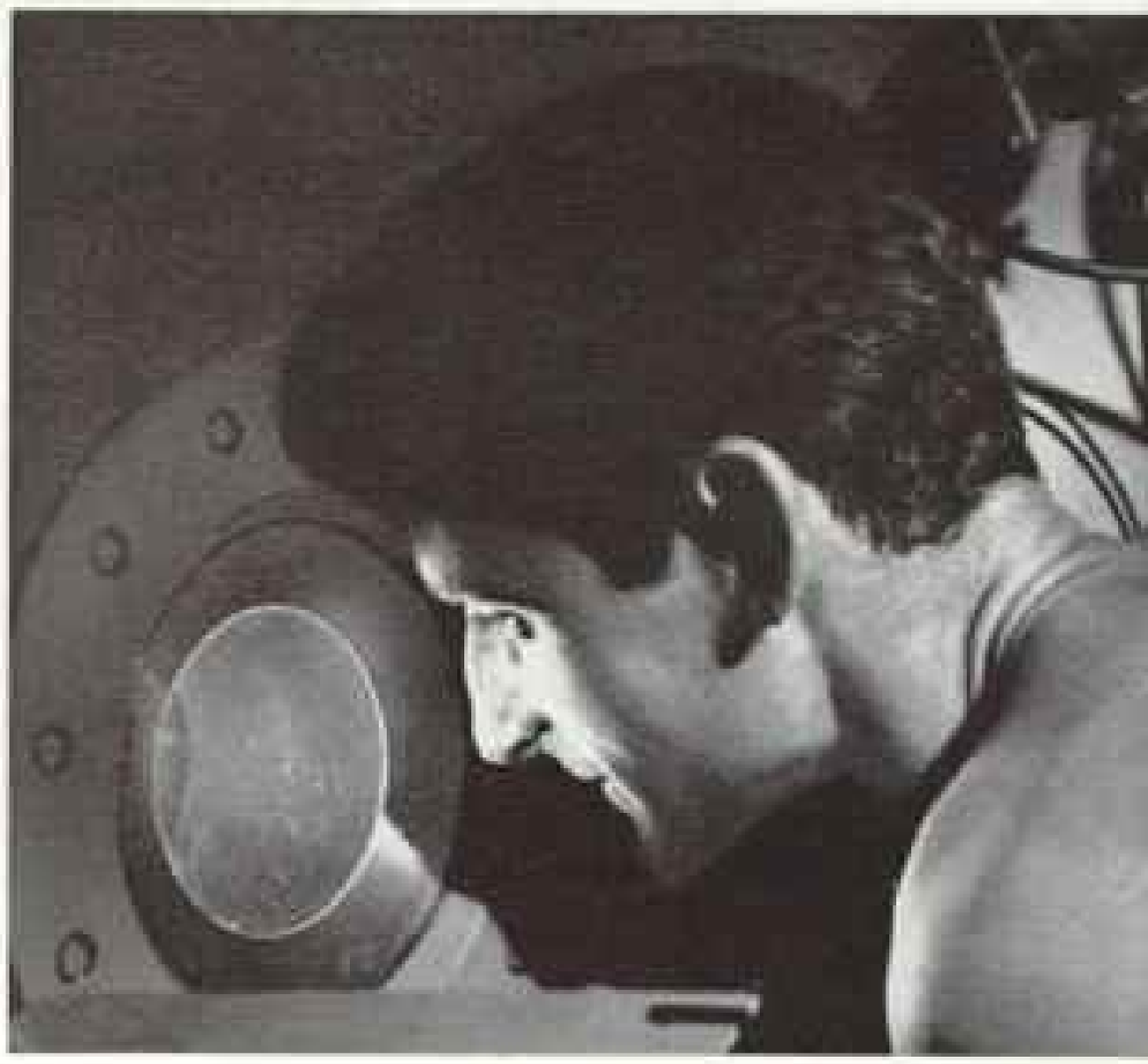
Diver meets metal monster in the deep. Aiming his movie camera like a bazooka,

the author catches the saucer skimming above the Caribbean's sandy floor.

Jean Mollard Stares at Fish; They Stare Back

Marine animals, showing no fear, inspected the saucer closely when it rested on the bottom. Invariably, observers reported, the fish swam to the front of the submarine and looked through the ports.

"The big thrill of my first dive was the behavior of the fish," says the author. "Who could have hoped they would be so clever? The saucer's noise under water is frightening. You hover near the bottom and switch on a motor—*whooo!* The fish have a jerk! But they stay there."



A welcoming committee of reef fish parades past the saucer. Pilot Falco tilts the bow upward by pumping mercury into a stern tank.

JACQUES RETARD

One special beauty, a large blue-and-yellow queen angelfish, passed closely in front of the camera. I wanted her farther away for a better shot, but she insisted on a close-up. This nonchalant behavior was common among the fish. It seems that not many are frightened by the saucer. . . ."

Thus Professor Edgerton confirms some good news. We had feared that the various noises of the diving saucer would alarm and scatter animals we wanted to observe. The contrary seems to be true. She attracts fish rather than repels them.

Saucer Stages an Underwater Show

For dive number 9, we plan a five-hour immersion. Falco is to plane up and down the reef slope from 50 to 230 feet deep. I swim down with Tom Abercrombie of the NATIONAL GEOGRAPHIC and Jacques Ertaud, our expedition photographer, to observe and film the poise and navigability of the machine.

I am surprised at how she turns "hard rudder." Falco streams toward me and cuts the port jet. As a former aviator, I subconsciously expect her to bank into the turn, but she skids flat for a few yards before making off to the left.

I start writing instructions for Falco on my dinner plate. We three Aqua-Lungers descend to 230 feet with *Denise*, like children lured into a dangerous wood by a radiant stranger.

Falco puts on a show of the saucer's hovering ability. He drives up to a tall, vaselike sponge. Ertaud stands in front of the jet sub, like a crewman bringing a plane in to a carrier deck, and motions Falco into position. *Denise* comes to rest two inches above the sponge without disturbing it.

There is one more saucer action to observe and film, the dropping of the 50-pound iron weight that finishes each dive. We return to the reeftop at a depth of 75 feet. I am about to give Falco the cue to jettison weight when there is a loud boom.

I fear a battery has blown up in the saucer. There is a silver-zinc battery inside for the electronic flash—are my friends the victims of an explosion in that cramped space? I swim to the saucer ports and look in. There are no reassuring faces at either porthole. It is a shocking moment.

Then a puzzled but smiling face appears in *Denise*'s left eye. Falco holds up a circled thumb and forefinger. They are all right! At the sound of the explosion, both he and Mollard had withdrawn from the windows to check the voltmeter.

Now I see furious bubbles rising out of the Fiberglas sheathings. There must be a short circuit in an outside battery. The stricken saucer begins to rise.

I beat the saucer to the surface and man the crane. Divers flip into the water and make fast the lifting tackle.

I haul the submarine to the deck. Now it is smoking furiously, and crewmen start spraying it with carbon-dioxide snow. I shout, "Stop until we get Falco and Mollard!"

Out comes the unharmed saucer crew. To get at the batteries, Falco jumps on the hull and pulls off the streamlining covers that enclose the equipment space. The carbon dioxide fails to smother the fumes.

"We'll put it out in the water," I say. In an instant the lifting tackle is hooked, the hatch is closed, and I am swinging *Denise* back into the water. The sea proves more efficient than our fire department.

It is all over. *Denise* is on deck surrounded by long faces as Edgerton fishes out the remains of the short-circuited battery. There is no other damage, but this technical difficulty halts our "driving lessons" in Guadeloupe. That night Mollard flies to Marseille to build new battery boxes, and the *Calypso* sails for São Tiago in the Cape Verde Islands.

There I know a very good test ground—Santa Clara Bay—perfectly sheltered from sea and winds.

Sub Stands as if Frozen in Jelly

Four weeks later, when we have Mollard's replacement batteries, my turn comes at last. I have lived a saucer dive so often in imagination that all is routine. I open the oxygen inlet and put on the electric fan. Falco opens two racks of carbon-dioxide absorbents. The hydraulic plant is turned on.

We enter gently into the water, and immediately the soft glow of blue ocean lights our faces through the portholes. The dive is scheduled to be a long one. We put the power on the jets at slow speed and glide down along the sloping bottom of dark-gray sand.

At about 260 feet, to our surprise, the saucer stops sinking and stays where she is, as if frozen in jelly. "Don't take any water in," I say to Falco. "We rest on the thermocline, a layer of colder, denser water. When we lose our warmth, we shall be less buoyant and sink again."

Soon we feel the chill and put on sweaters. And the saucer starts down once more.

Suddenly at the depth of 360 feet we become aware of something wrong. The saucer hits the bottom and stays there, sluggish. Then in the silence we hear bubbles! First a few. Then more, like water boiling in a kettle.

"The batteries again," we say, and look at each other. "Back to the surface," I order. "Drop the 50-pound navigation weight."

The saucer slowly rises above the bottom, while the sound of bubbles keeps increasing. The voltmeter swings often to zero, confirming a bad short circuit in the batteries. Inside them gas has developed, and the pressure has exploded the battery cases.

Falco turns to me with an alarming quietness. "Look, Commandant," he says. "We sink again."

Through the porthole I see that particles suspended in mid-water move up, proving we go down. The bottom gets nearer.

I prefer to keep to myself the little ugly pinch I feel in my heart for a fraction of a second. Then reason and confidence come back. I cut the safety tape and turn the lever that releases the 330-pound emergency weight. There is not a noise, but immediately the saucer tilts its tail up about 30 degrees and rises swiftly, irresistibly to the surface.

"Falco," I say, "they don't expect us up so early. We might as well have a snack."

The chicken sandwiches and red wine, now that our emergency is over, taste superb.

Denise Dives for 1,000-foot Goal

We move into the Mediterranean off Corsica while *Denise*'s batteries are being repaired. Then Falco and I go down again. "This time we shall try for 1,000 feet," I say.

Divers wave goodbye at 200 feet as we move down the steplike bottom. At 400 feet we settle on the edge of a steep incline for a careful check of our little craft.

Then Falco pumps mercury forward, and the sub tilts 35 degrees. *Denise* motors off down the slope. Steadily our instruments mark the depth . . . 600 feet . . . 800 . . . 950. At 1,001 feet, there is a gentle bump; *Denise* touches bottom. At last she is where we want her!

The trip upward is breath-taking. We glide around huge rocks and cliff faces, their colors shining under our lamps. Four hours after setting out, we surface. Our trip is over. But it is only the beginning of explorations we know our jet sub will make.

Aqua-Lung divers wave goodbye and snap a final flash picture as the saucer heads down-slope into the unexplored depths. The jet sub's cruising speed: 1½ knots.

JACQUES EWTAUD

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GEOGRAPHIC WRITER RIDES A SPACE AGE ARMCHAIR

Strapped like a mummy on a board, Assistant Editor Allan C. Fisher, Jr., soon may be muttering into his lip microphone, "Which end is up?" His tottering throne will whirl crazily, and his feet and head will swap positions with dizzying rapidity.

Fisher rides MASTIF (for "multiple axis space test inertia facility"), a training device of the National Aeronautics and Space Administration at Lewis Research Center, Cleveland, Ohio. Spinning on three axes, the contour chair simulates the wild pitching and careening that Mercury astronauts will meet when their blazing capsule, hurtling back from space, slashes into the sea of air.

With his right hand Fisher controls jets countering roll, pitch, and yaw. His left holds the "chicken switch" for halting the ride. He didn't use it.

Since Allan Fisher began writing his award-winning aviation and science articles for the GEOGRAPHIC ten years ago, he has faced many an unsimulated emergency, including a belly landing in a T-33 jet. Members who want an armchair ride in MASTIF can share his seat when he reports on NASA and the space program in an early issue.

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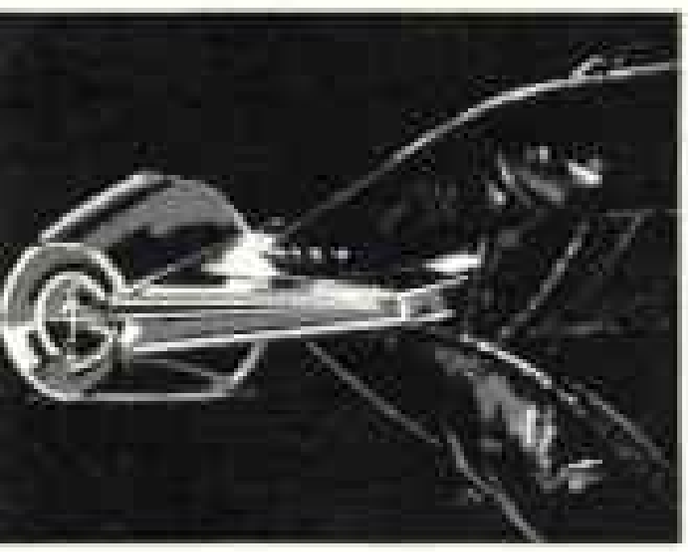

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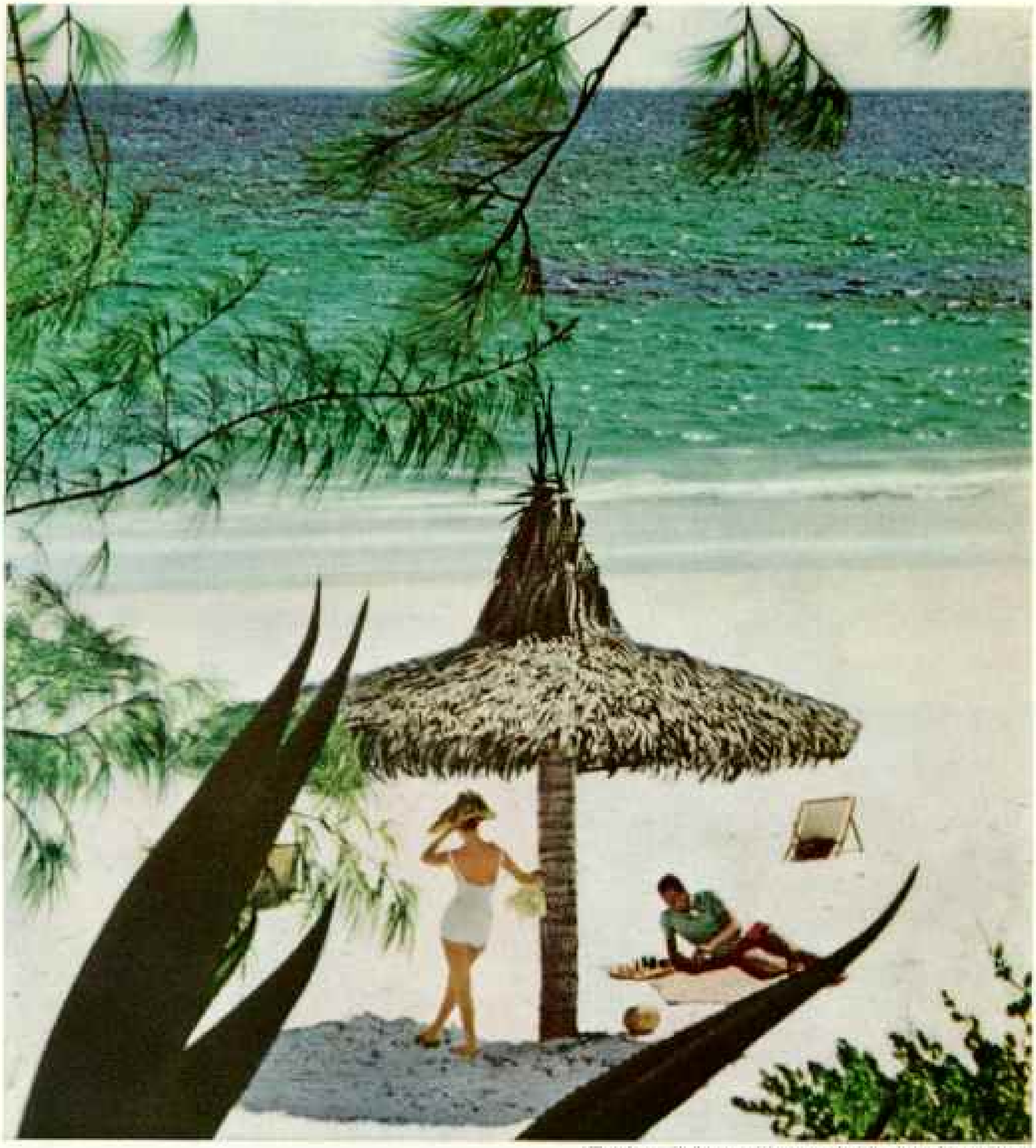

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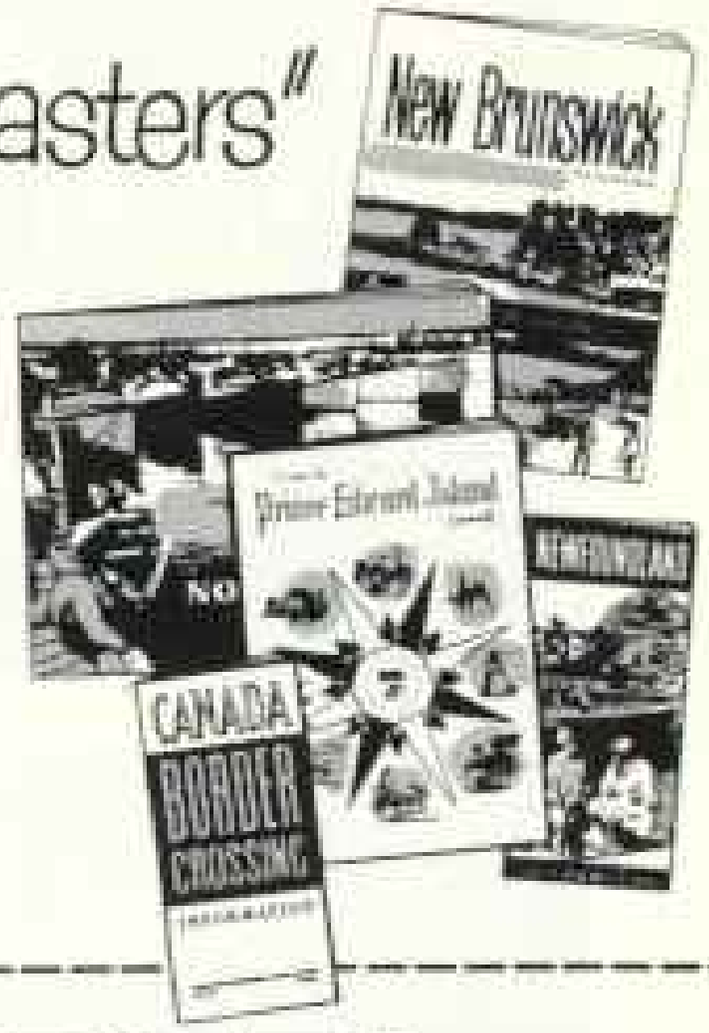

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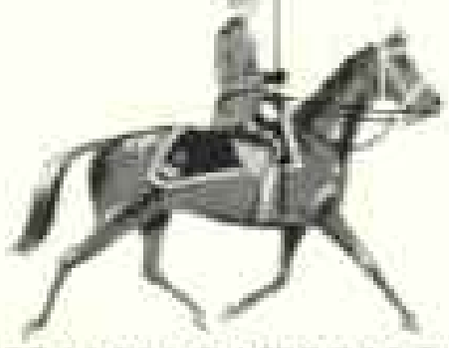

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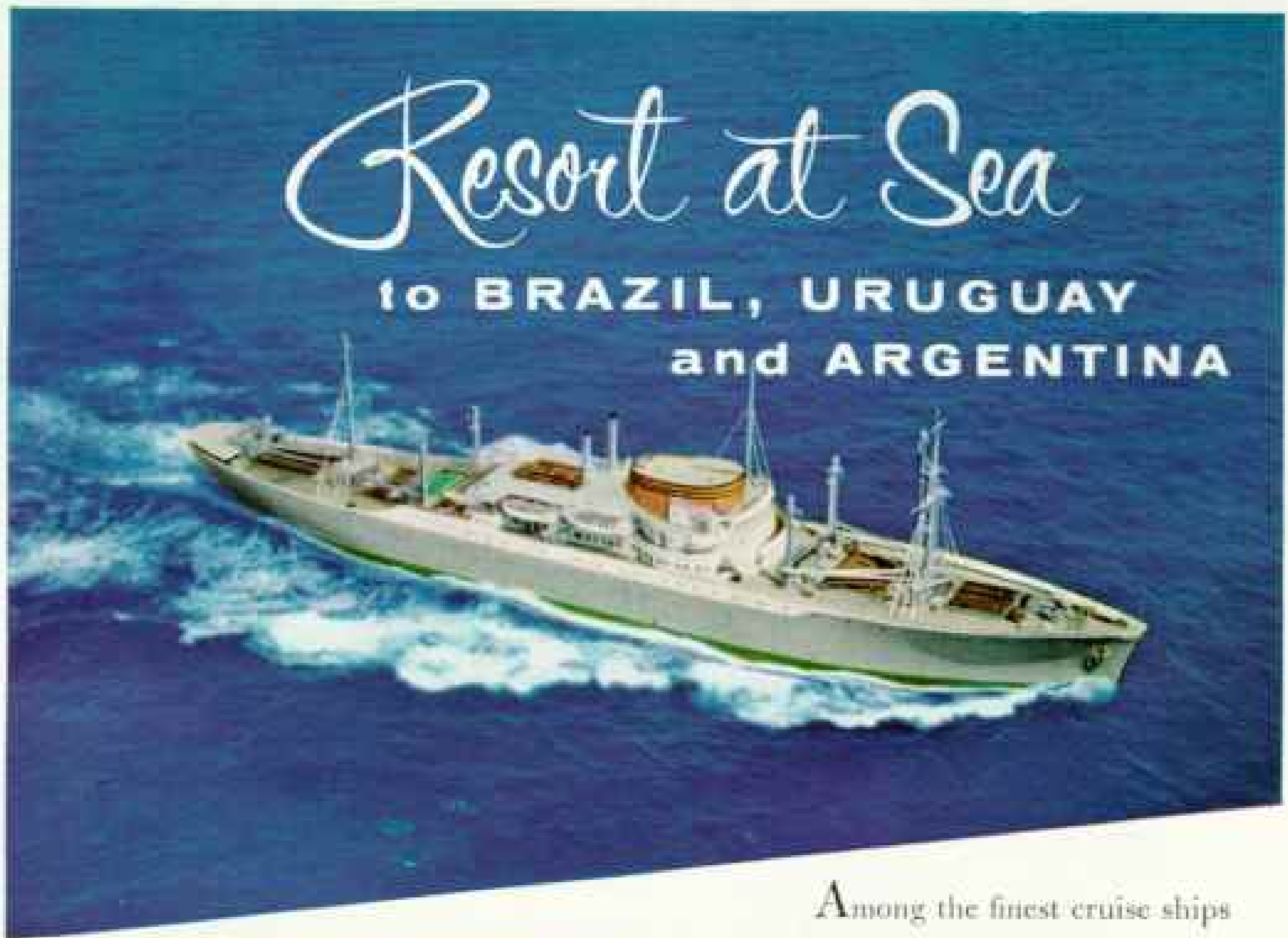

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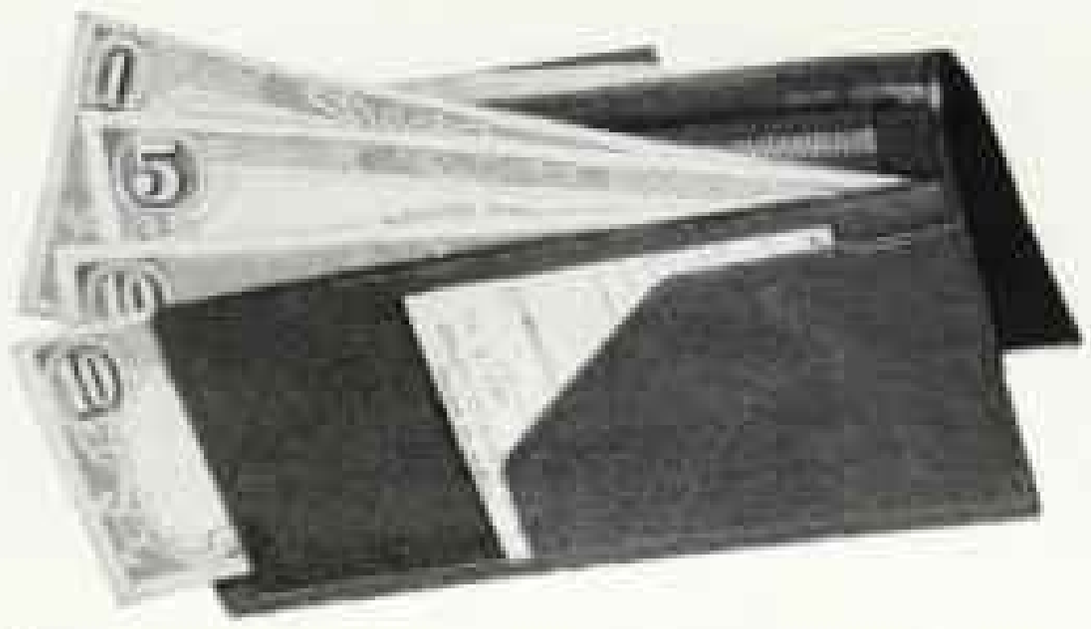

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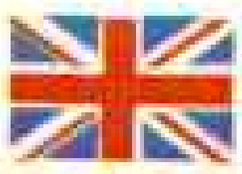

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It virtually eliminates tire squeal. And you can easily get *4,000 to 5,000* additional miles of motoring—*all at regular tire prices.* See them at your nearby Firestone Dealer or Store!

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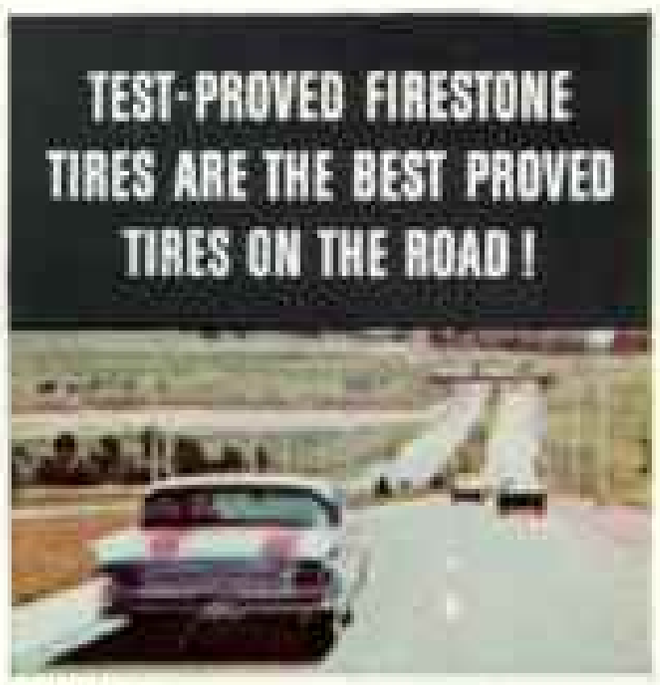

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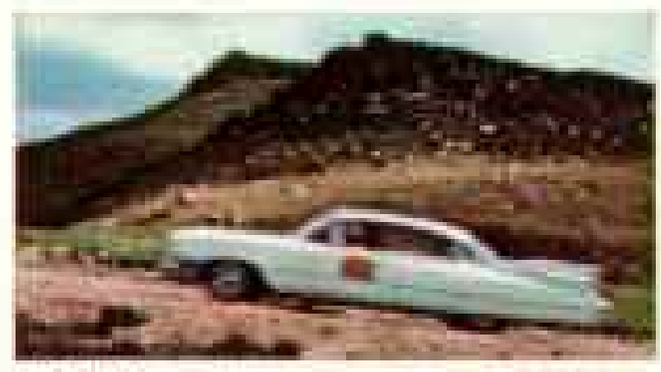

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of sweet, spirited performance...of uncommon elegance and comfort ...of exclusive details...of sound basic value for the years to come

Start with the distinctive Thunderbird silhouette—the shape that looks like stopped motion. The smart, unaffected design that promises sports-car roadability and handling ease with luxury-car comfort . . . the great basic design that makes Thunderbird an automotive classic.

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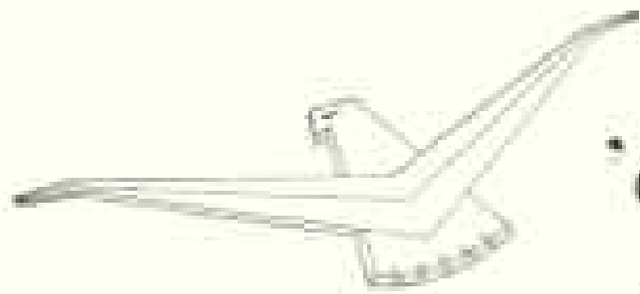

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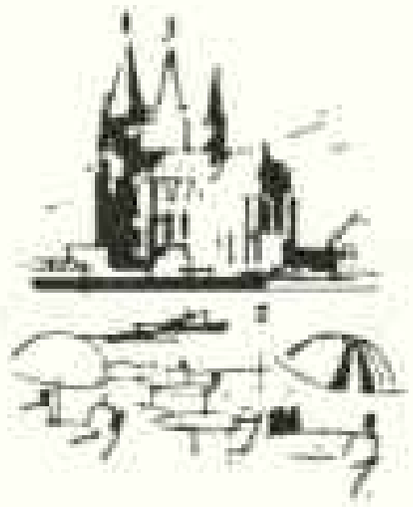

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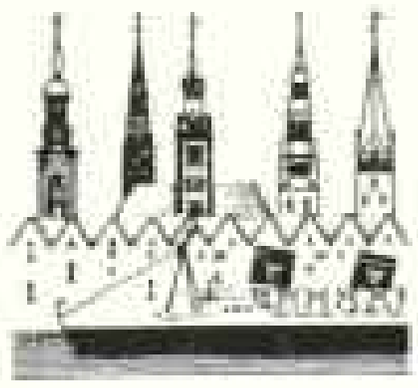

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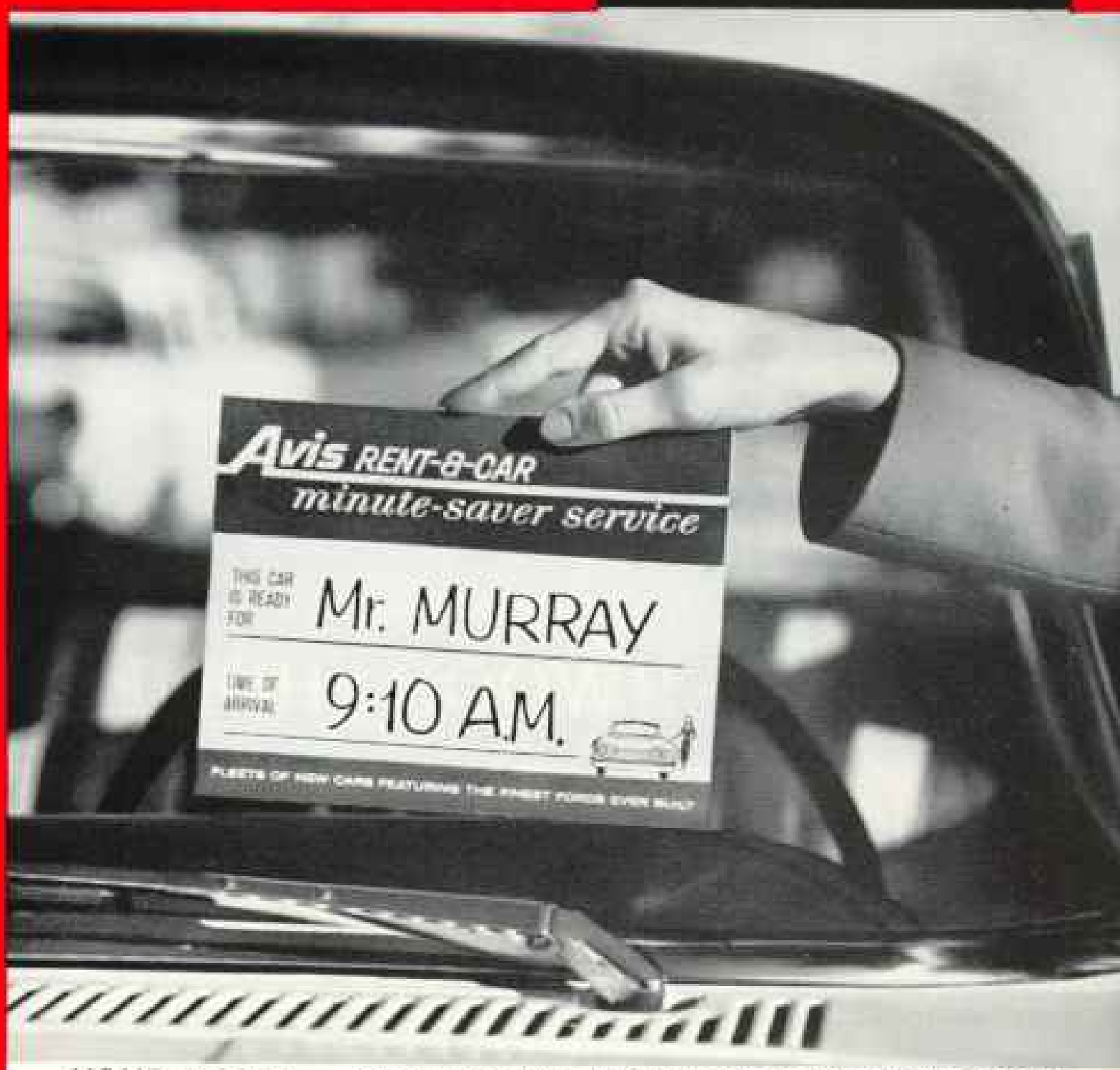

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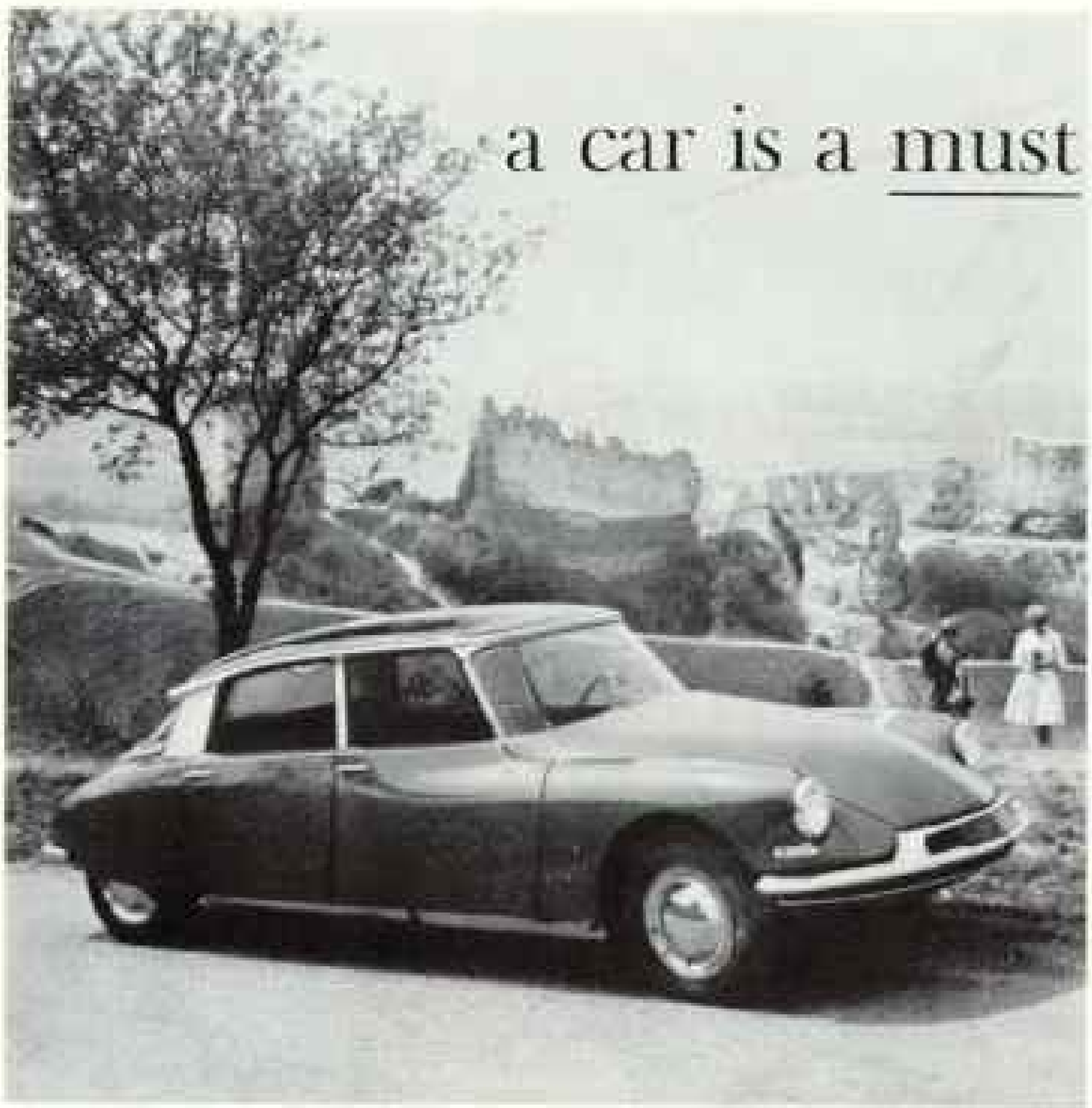

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Preferred by many who take special pride in their lawns . . . Eclipse precision reel-type mowers—18" to 25" models—give a smooth shearing action that's ideal for Bermuda, Zoysia, and St. Augustine, as well as blue grasses.

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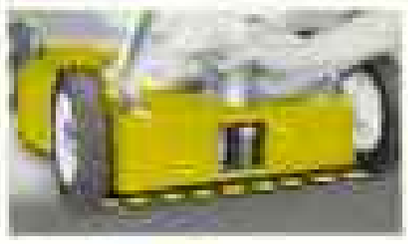
GRASS CATCHER
(Optional extra)

Collects clippings as they leave discharge chute. Easily attached. Fits all Eclipse walking rotary models.

EASY CUTTING HEIGHT ADJUSTMENT



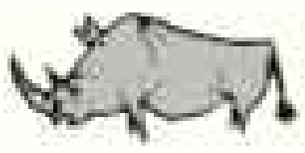
It's brand new and exclusively Eclipse! A simple twist of one control adjusts all four wheels simultaneously. Select any cutting height between 1½" and 3½"—even while mower is operating.

13 MODELS PRICED FROM $69.95

*DESIGN AND CONSTRUCTION TO OUTPERFORM ALL ORDINARY MOWERS YEAR AFTER YEAR—FOR THE LOWEST ANNUAL OPERATING COST

RUGGED AS A RHINO

Inside and out—from stem to stern—Eclipse mowers are built to "take it." Many Eclipse mowers 20, 30, or even 50 years old are still on the job and cutting efficiently.



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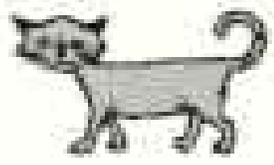

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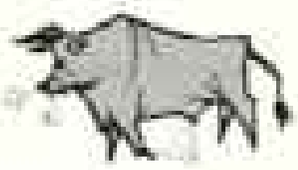

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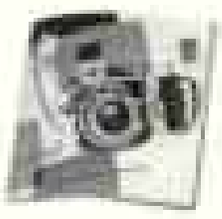

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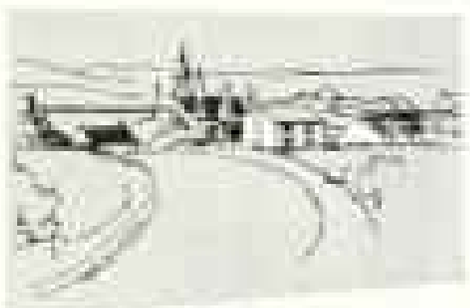

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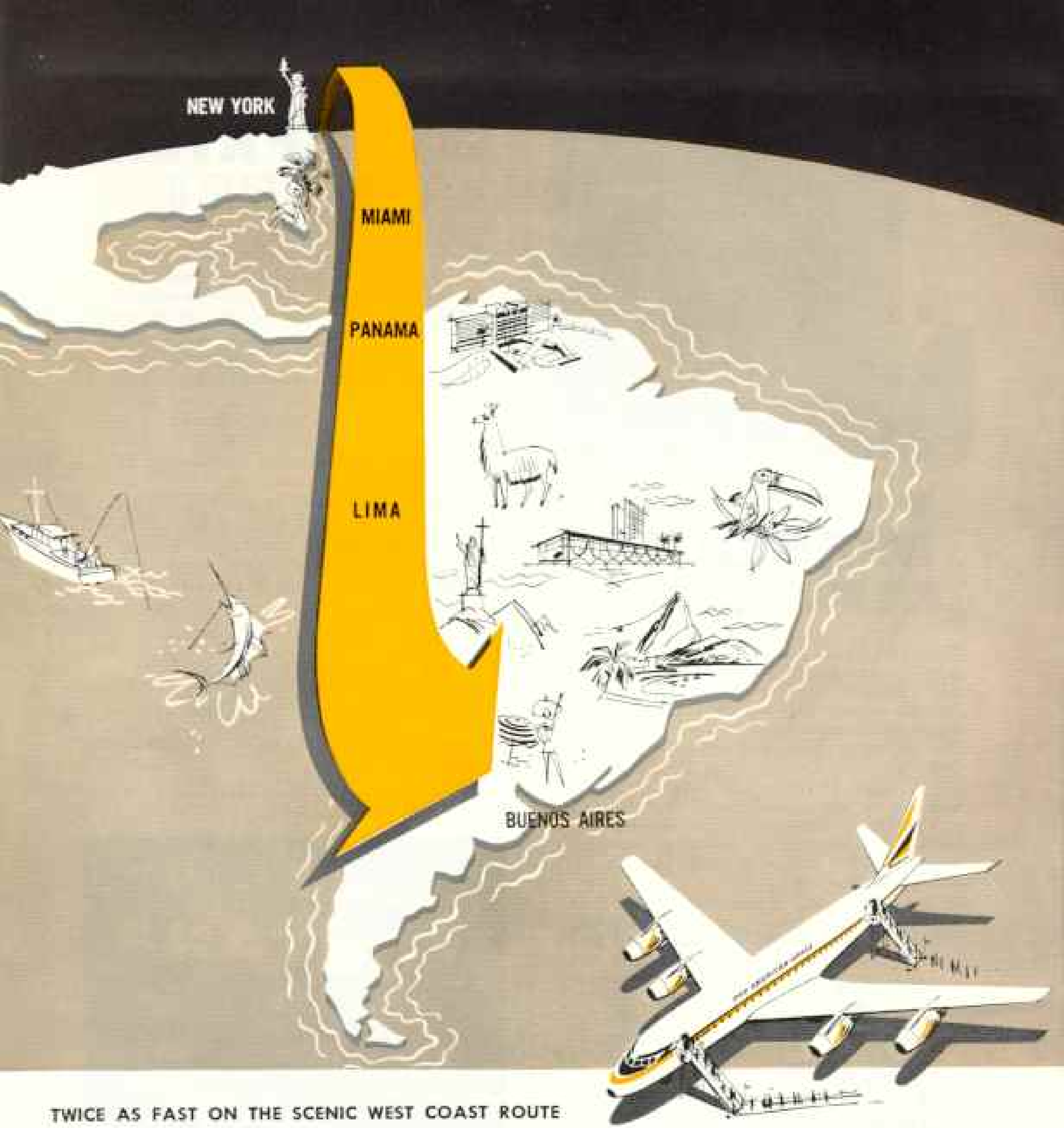

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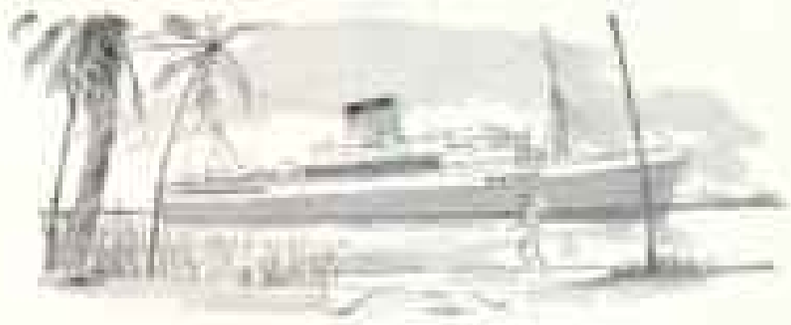

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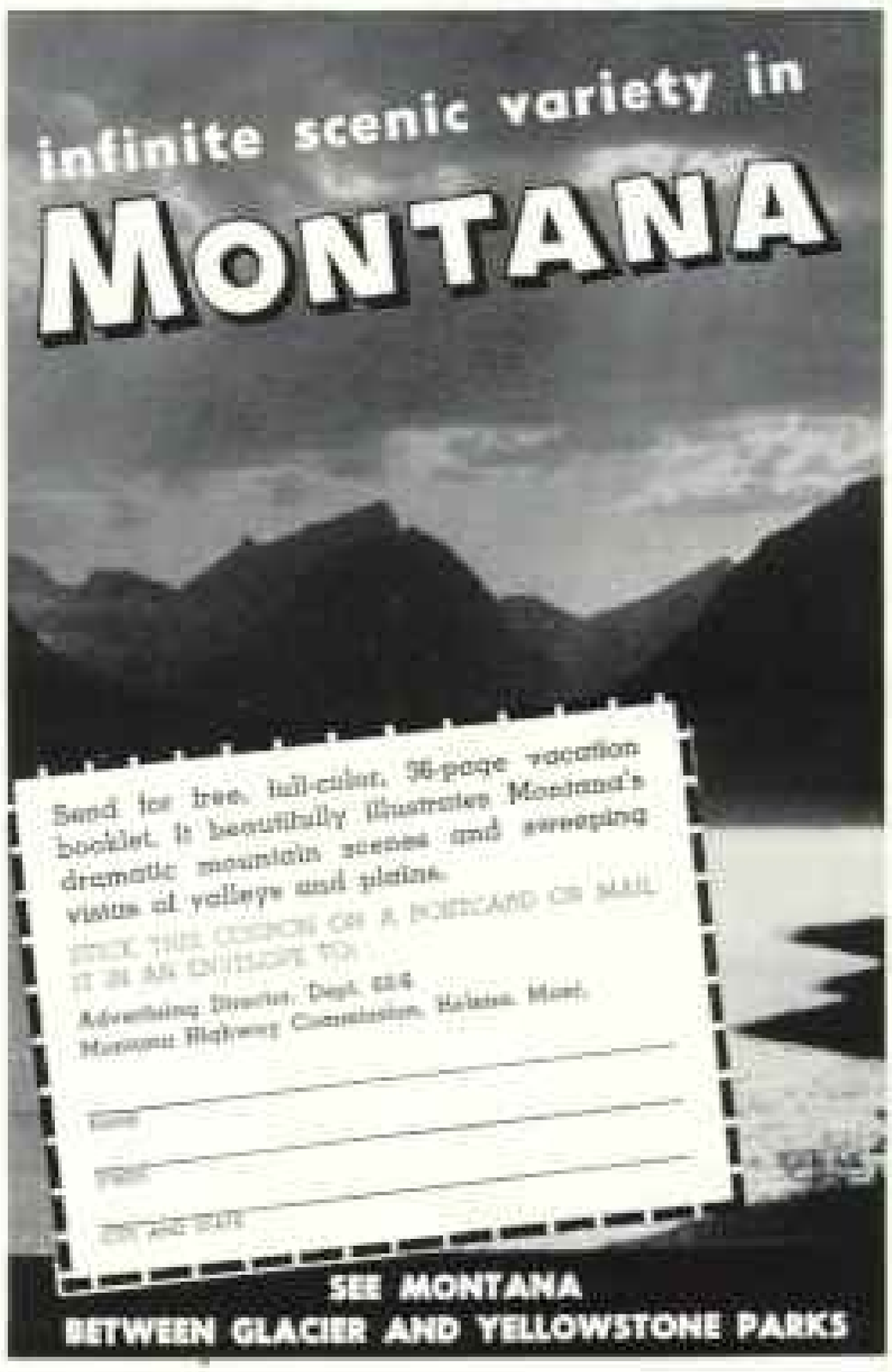

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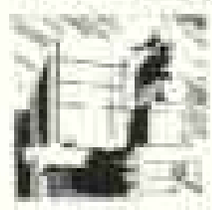

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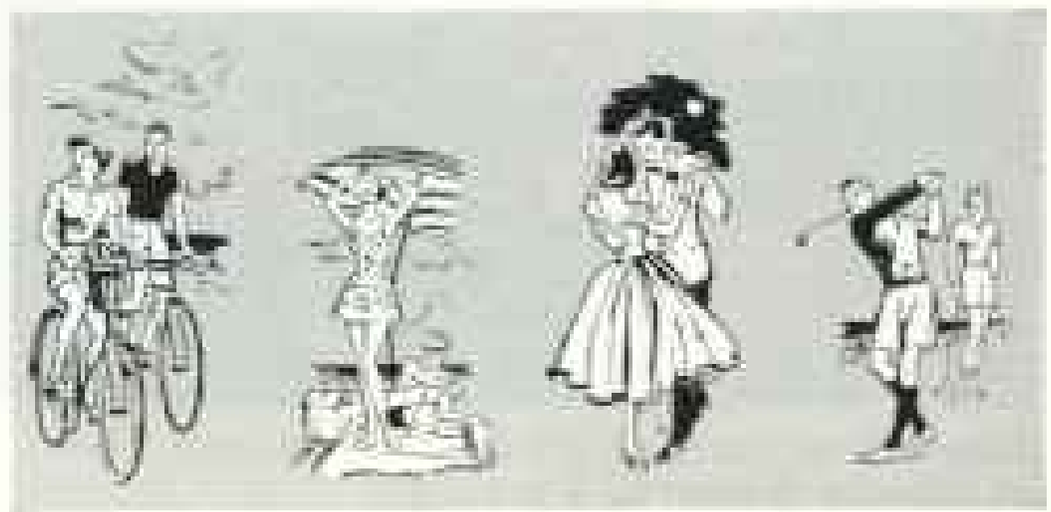

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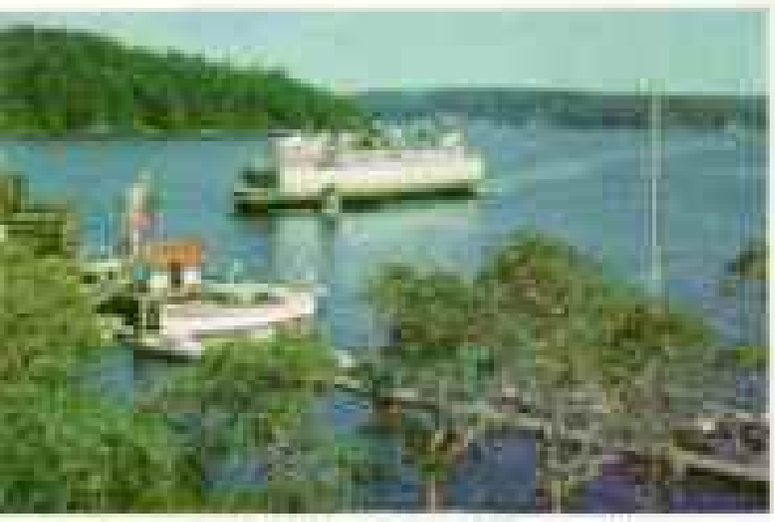

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Since alcoholism is among our most important health problems, it deserves attention. These questions and answers may give you a better understanding of it.

Why do people become alcoholics?

Medical science does not yet know the precise cause or causes of alcoholism. Authorities agree, however, that emotional difficulties—tension, worry, guilt and other dreaded feelings—are certainly connected with alcoholism. The alcoholic drinks to escape his inner conflicts. And he becomes so dependent on alcohol that he cannot face life without it.

What are the warning signs of alcoholism?

When a person starts "gulping" alcohol to "fortify" himself, trying to hide from others how much and how often he drinks, drinking alone or in the morning, giving strange excuses for his behavior, having trouble on the job or at home . . . addiction to alcohol may be in the offing. It may develop quickly—within a few months—or slowly over a period of years.

Can an alcoholic recover?

Recovery depends on the alcoholic's own fundamental desire to stop drinking—and, having stopped, never to drink alcohol in any form again.

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What should you do to help an alcoholic?

Face the problem without embarrassment, anger or resentment . . . just as you would any other serious threat to your home and your family.

The family—especially those members closest to the alcoholic—should seek help from someone who knows the problem. The family doctor, or a clergyman, or a social worker, or a trusted friend may be able to advise you about the best course to take.

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For Family guidance write to Al-Anon Family Groups. The address is P.O. Box 182, Madison Square Station, New York 10, N. Y.

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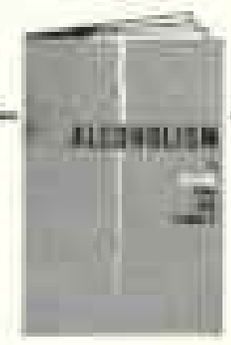

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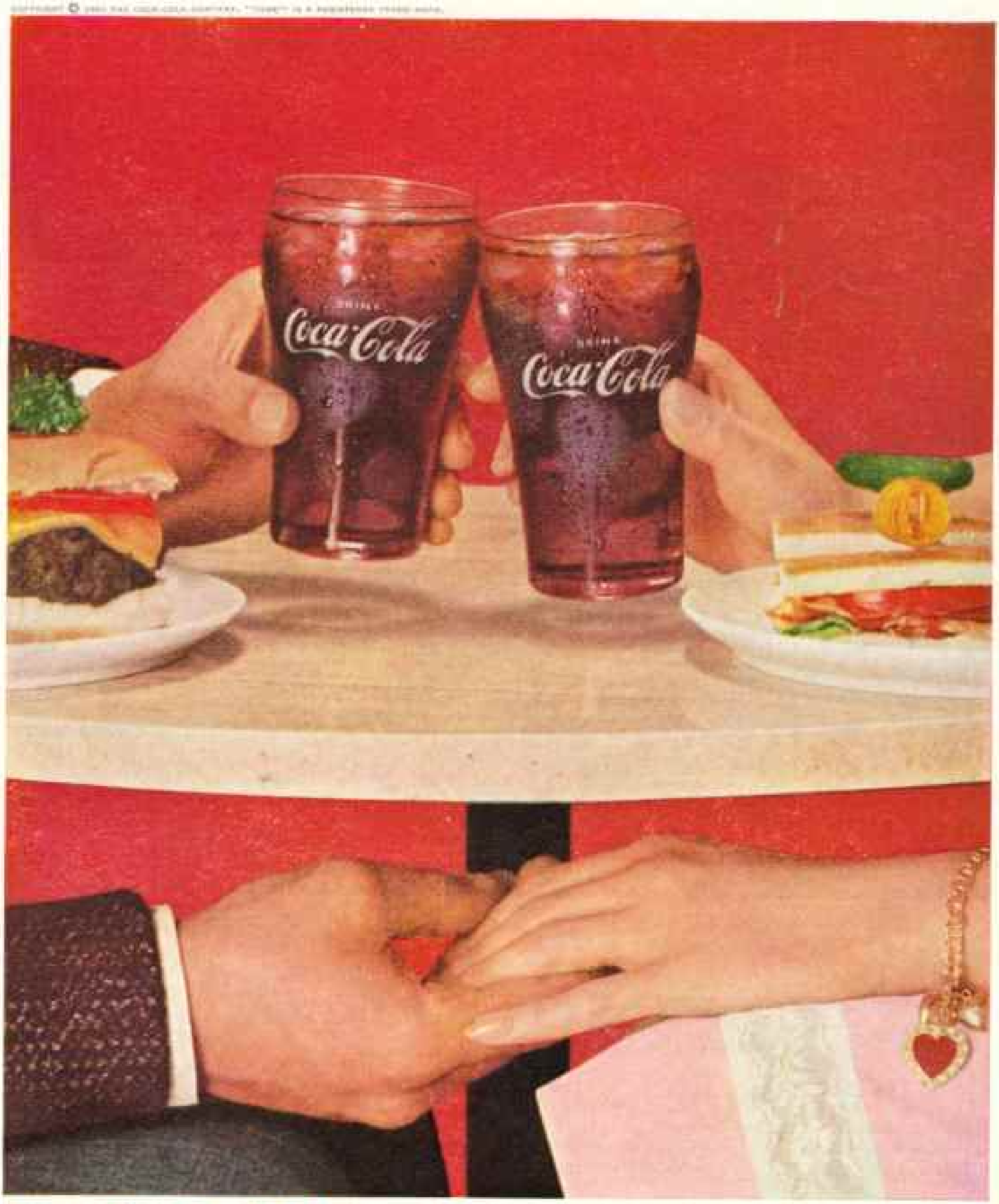

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No. 5 (continued from NGM December 1959 issue)

by Georges Caspari

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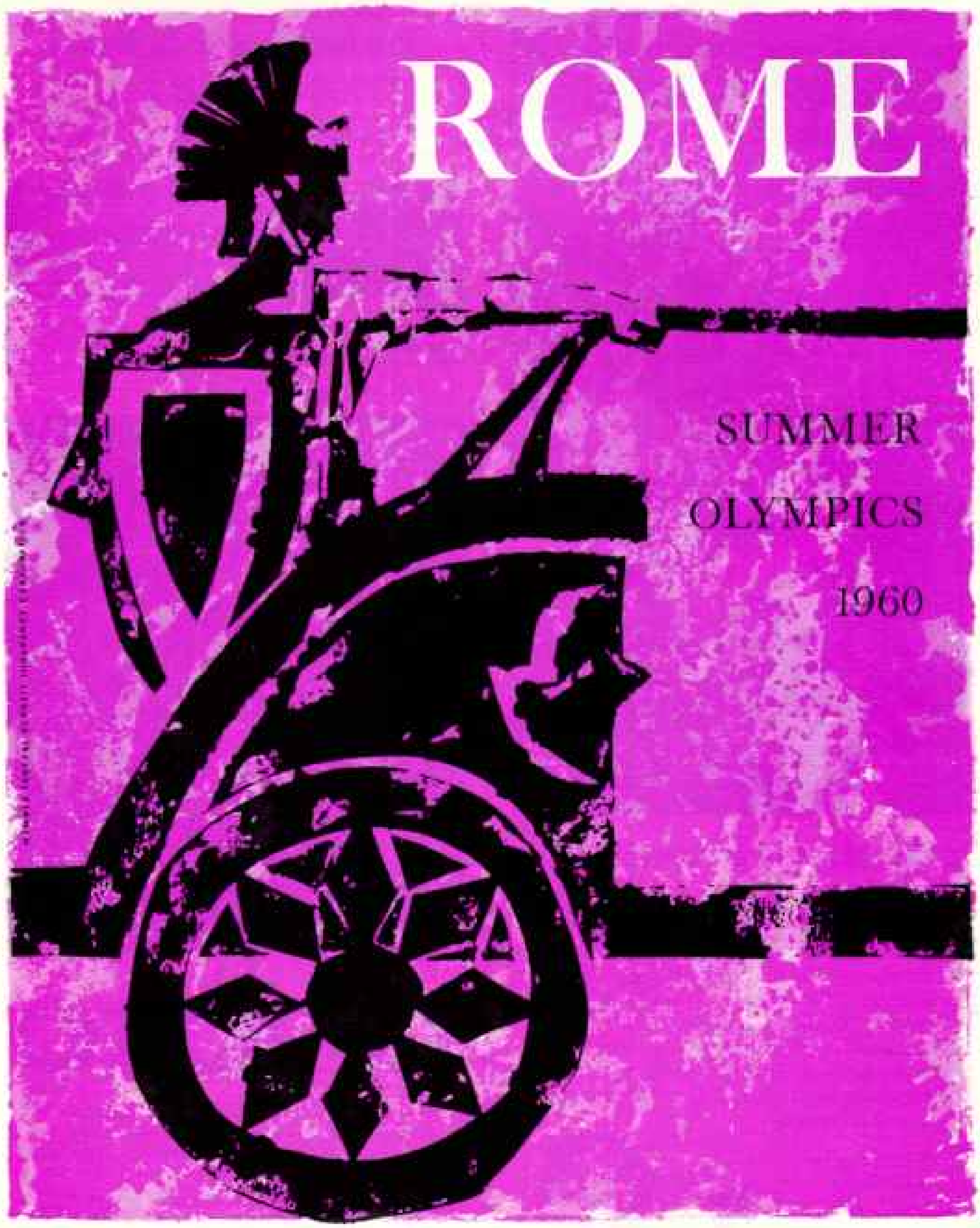

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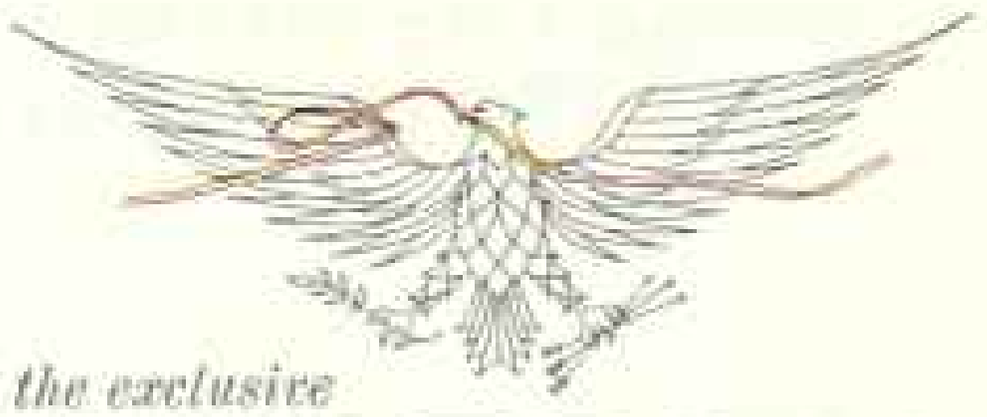

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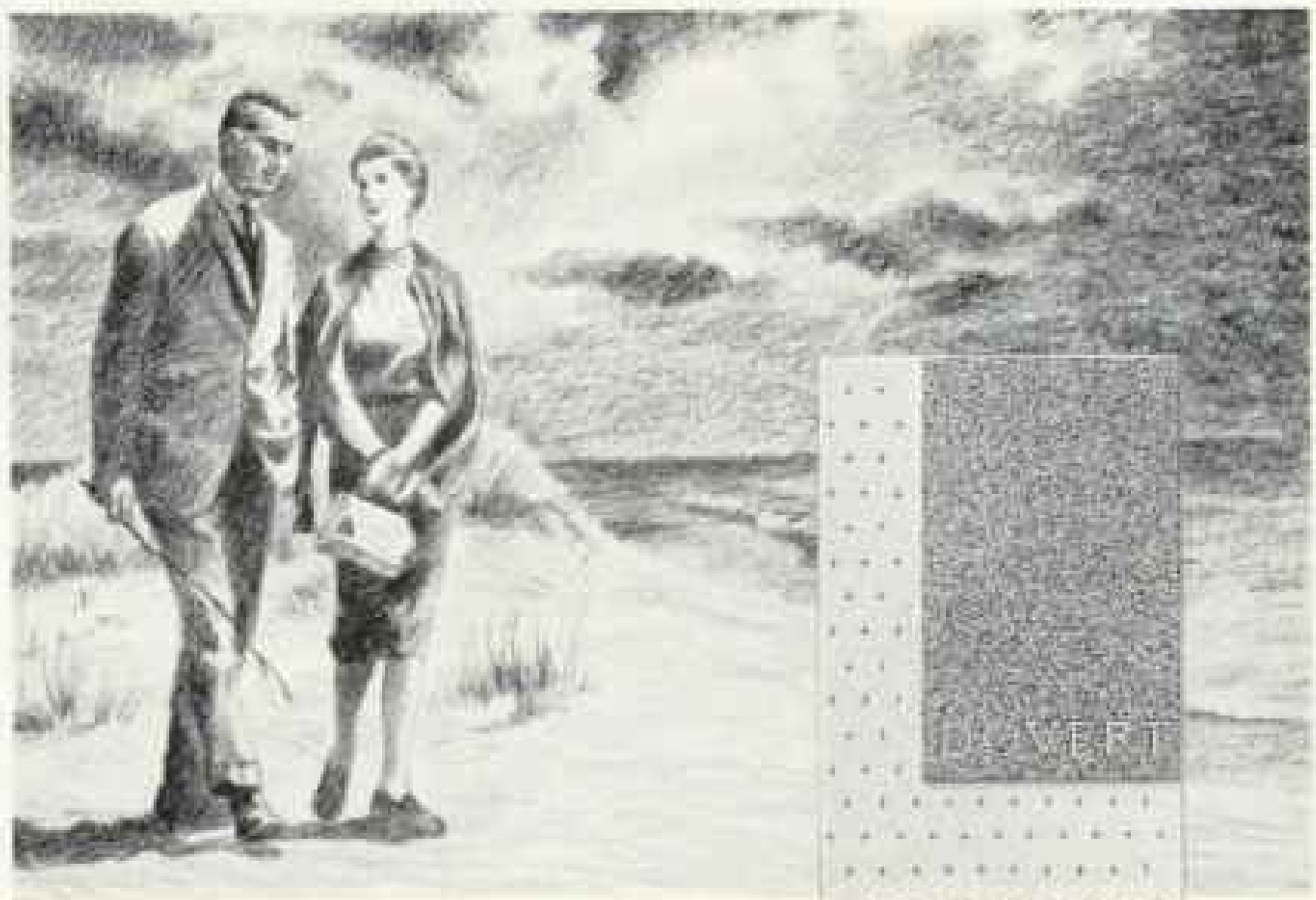

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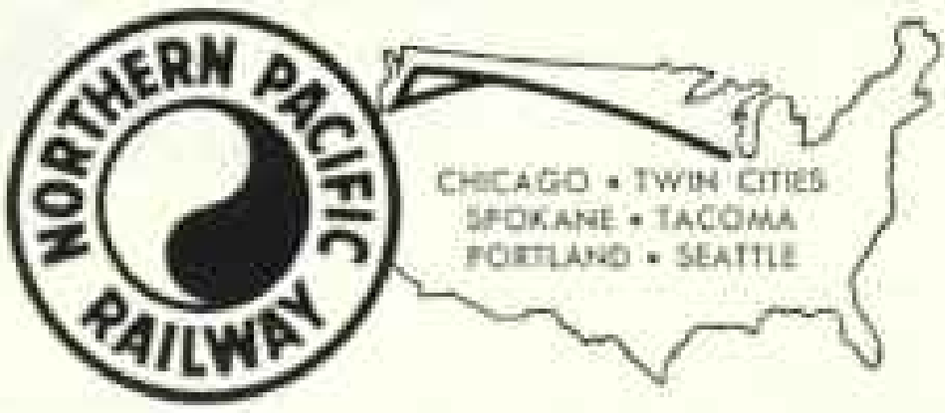

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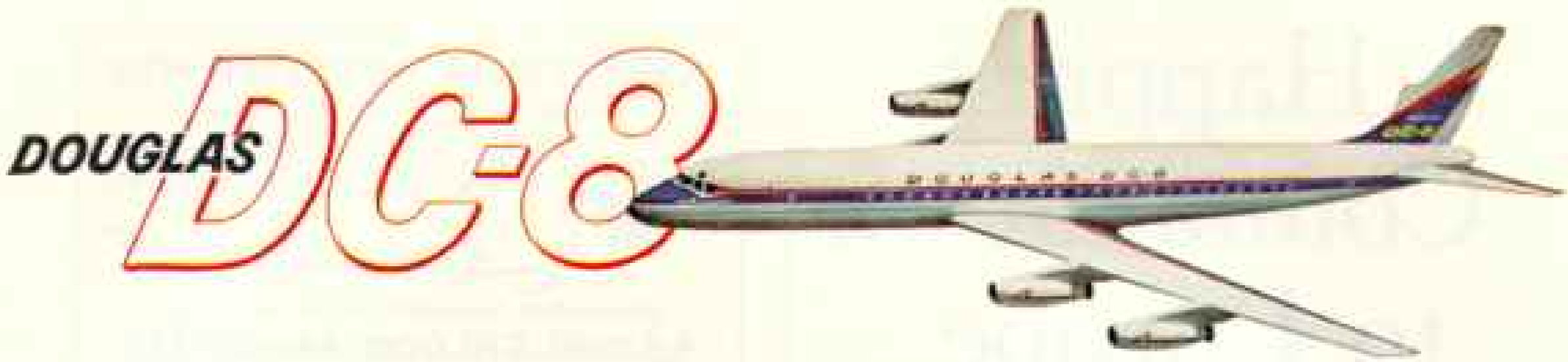

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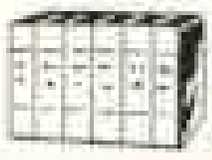

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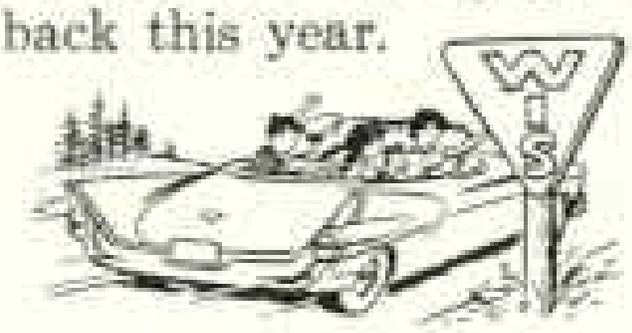

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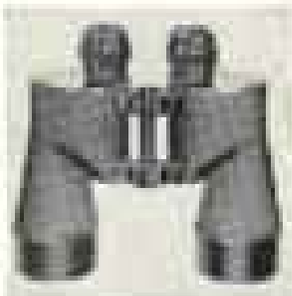

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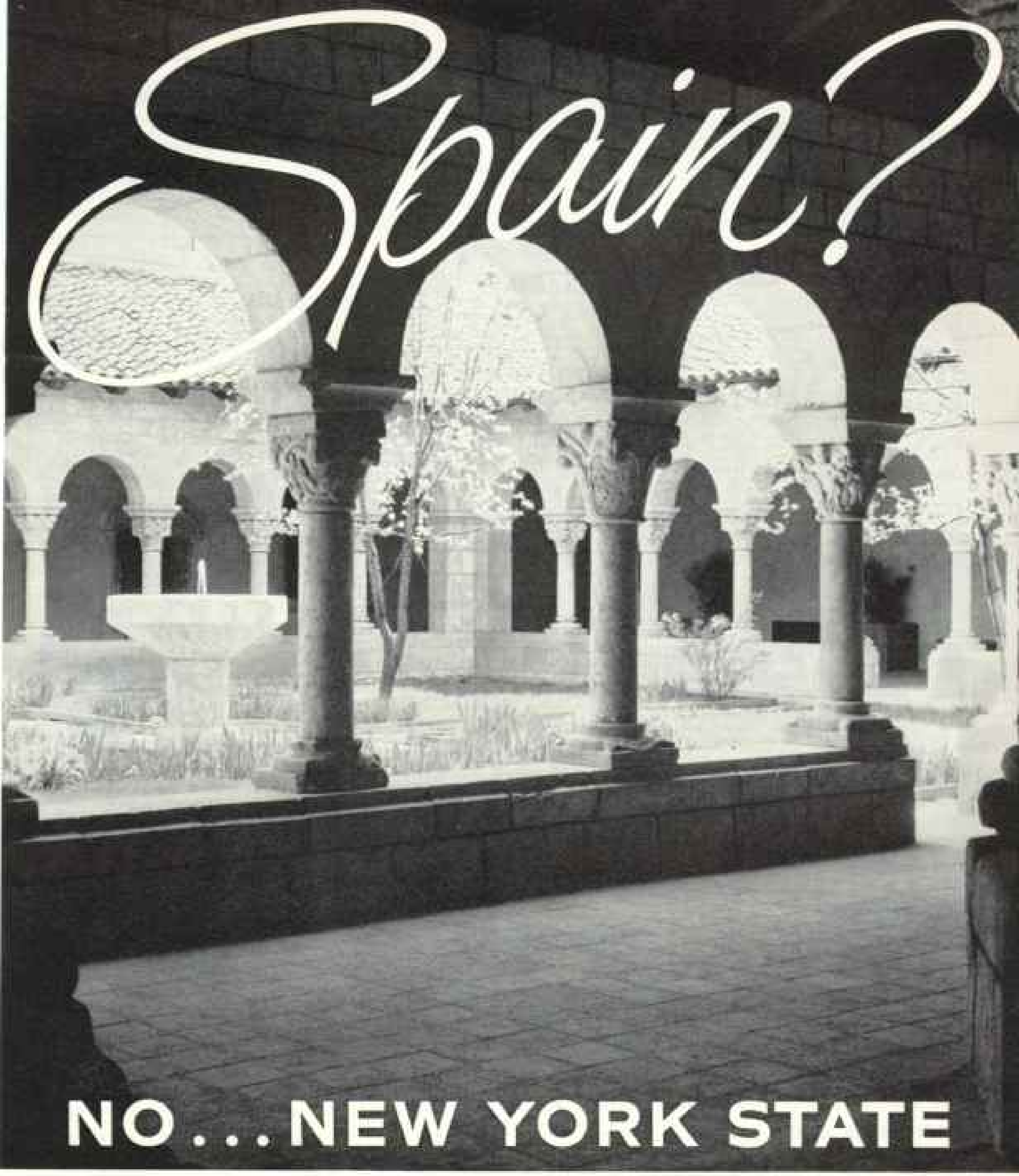

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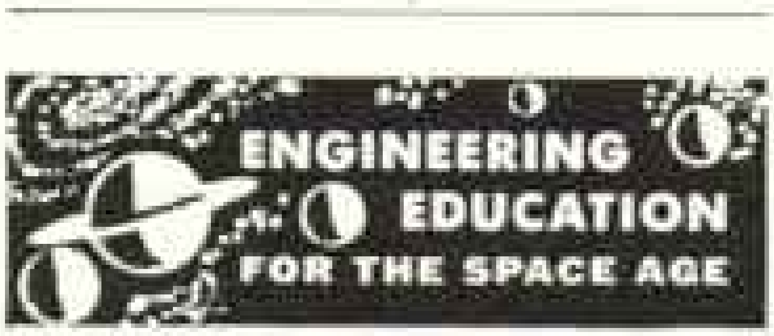

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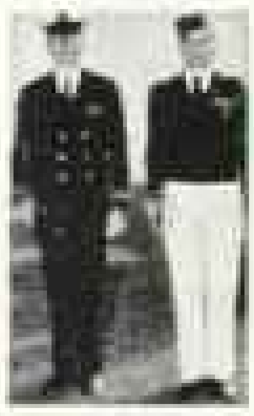

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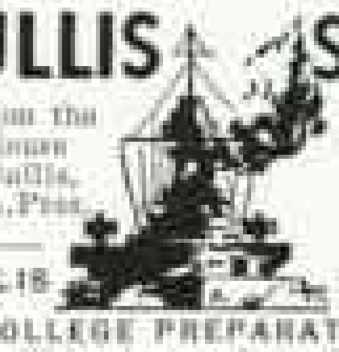

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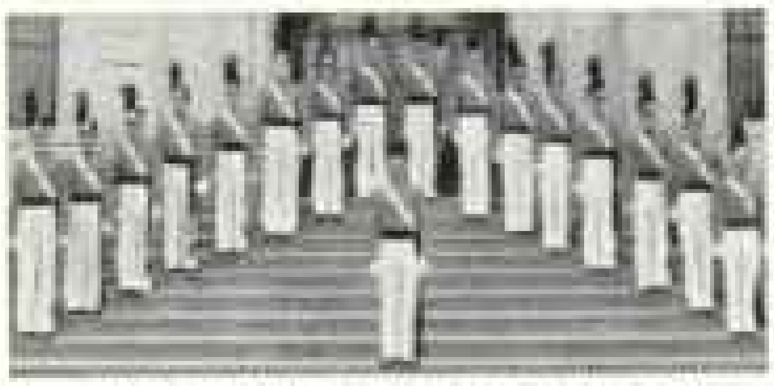

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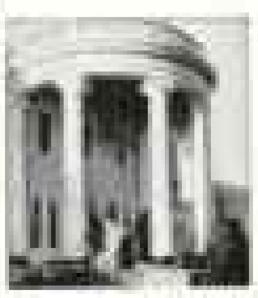

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